Factors contributing to the adequate vitamin A status and poor anthropometric status of 24-59-month-old children from an impoverished Northern Cape community

by
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Thesis presented in partial fulfilment of the requirements for the degree Master of Nutrition at the University of Stellenbosch

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March 2013

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ABSTRACT

Factors contributing to the adequate vitamin A status and poor anthropometric status of 24-59-month-old children from an impoverished Northern Cape community

Objective: To examine the factors that may influence the vitamin A and anthropometric status of 24-59-month-old children from an impoverished community with a very high prevalence of stunting, but virtually no vitamin A deficiency.

Design: Cross sectional, descriptive study with analytical components.

Setting: Calvinia West, Northern Cape Province, South Africa

Subjects: Biological mothers (n=150) and their children aged 24-59 months (n=150) living in Calvinia West from 6 months of age or younger.

Methods: A general interviewer-administered questionnaire comprising of socio-demographic information, a 24-hour recall and an adjusted food frequency questionnaire, focussing on liver intake, were used in the data collection process. Anthropometric measurements (weight and height) were also performed.

Results: Results showed that liver consumption alone contributed to more than 100% of the Estimated Average Requirement (EAR) for vitamin A of the pre-school children in this community. Liver was eaten by 84.7% (n=127) of the children and 68% (n=102) of them ate liver at least once per month. The average portion size of the children who consumed liver was 66g at a time. The national food fortification programme contributed to a further 80 µg Retinol Equivalents (RE) and the national supplementation programme 122µg RE of vitamin A per day. There was a significant (p=0.028) inverse association between the amount of liver intake and household income. Liver intake was also significantly (p=0.016) higher in the children whose mothers were unskilled as opposed to those with skilled mothers.

According to the World Health Organization (WHO) growth standards 36.9% (n=55) of the children were stunted (low height for age), 25.5% (n=38) were underweight for age and 12.1% (n=18) were wasted (low weight for height). The mean birth weight of the children (n=141) was 2826g (SD=592). Of these children, 27.7% (n=39) had a low birth weight (<2500g). There was a significant positive correlation (r=0.250; p=0.003) between the birth weight of the child and the child's current height for age. The height of the mother, as well as several indicators of socio-economic status, also correlated significantly with the height for age of the child.

Conclusion: In this impoverished community the anthropometric status of the children was poor, but vitamin A deficiency was largely addressed through the regular intake of liver. Poor anthropometric status is therefore not always an indicator of micronutrient deficiencies and blanket supplementation

approaches are not necessarily the solution in a country with diverse cultures and eating habits. Apart from the immediate risks and consequences of underweight, stunting and wasting in a community, stunting may also lead to overweight and obesity in the long term. This may result in diseases of lifestyle in later life, adding a further burden to an already weakened community. Appropriate evidence-based interventions aimed at the first thousand days of life should be a priority in this community.

OPSOMMING

Faktore wat bydra tot die voldoende vitamien A en swak antropometriese status van kinders, 24-59-maande oud in ‘n lae sosio-ekonomiese gemeenskap in die Noord Kaap

Doel: Om die faktore wat kan bydrae tot die vitamien A en die antropometriese status van kinders 24-59-maande in ‘n arm gemeenskap met ‘n baie hoë voorkoms van dwerggroei, maar byna geen vitamien A gebrek, te ondersoek.

Ontwerp: Beskrywende, deursnit studie met analitiese komponente

Omgewing: Calvinia Wes, Nood Kaap provinsie, Suid-Afrika

Deelnemers: Biologiese moeders (n=150) en hul kinders in die ouderdomsgroep, 24-59-maande (n=150) woonagtig in Calvinia Wes sedert 6 maande van ouderdom of jonger.

Metodes: ‘n Vraelys bestaande uit sosio-demografiese inligting, ‘n 24-uur herroep en ‘n aangepaste voedsel frekwensie vraelys gefokus op die inname van lewer, was gebruik om data in te samel en voltooi deur die onderhoudvoerder. Antropometriese metings (gewig en lengte) was ook geneem.

Resultate: Resultate het getoon dat lewer inname bygedra het tot meer as 100% van die geskatte gemiddelde behoefte van vitamien A vir die voorskoolse kind in hierdie gemeenskap. Lewer was deur 84.7% (n=127) van die kinders ingeneem en 68% (n=102) het dit ten minste een keer per maand geëet. Die gemiddelde porsie grootte van die kinders wat lewer ingeneem het, was 66g op ‘n keer. Die nasionale voedsel fortifisering program het ‘n verdere 80 µg Retinol Ekwivalente (RE) en die nasionale supplementasie program 122µg RE vitamin A per dag bygedra. Daar was ‘n betekenisvolle (p=0.028) omgekeerde korrelasie tussen die die hoeveelheid lewer wat deur die kinders ingeneem is en die huishoudelike inkomste. Lewer inname was ook betekenisvol (p=0.016) meer in kinders wie se moeders ongeskool was teenoor die met geskoolde moeders.

Volgens die Wêreld Gesondheid Organisasie se groeistandaarde het 36.9% (n=55) van die kinders dwerggroei getoon (te kort vir hul ouderdom), 25.5% (n=38) was ondergewig vir hul ouderdom en 12.1% (n=18) uitgeteer (ondergewig vir hul lengte). Die gemiddelde geboortegewig van die kinders (n=141) was 2826g (SA=592). Van hierdie kinders het 27.7% (n=39) ‘n lae geboortegewig (<2500g) gehad. Daar was ‘n betekenisvolle positiewe korrelasie (r=0.250; p=0.003) tussen die geboortegewig van die kind en die huidige lengte vir ouderdom. Die lengte van die moeder, sowel as ander sosio-ekonomiese status aanwysers het ook betekenisvol gekorreleer met die lengte vir ouderdom van die kind.

Samevatting: In hierdie arm gemeenskap was die antropometriese status van die kinders swak, maar vitamien A gebrek was grootliks aangespreek deur die gereelde inname van lewer. ‘n Swak antropometriese status is dus nie altyd ‘n aanduiding van mikronutriënt tekorte nie en ‘n

oorkoepelende aanslag van supplementasie is nie noodwendig ‘n oplossing in ‘n land met diverse kultuur en eetgewoontes nie. Behalwe vir die onmiddelike gevare van ondergewig, dwerggroei en uittering in ‘n gemeenskap, het kinders met dwerggroei ‘n groter risiko om oorgewig en vetsugtig te word in die langtermyn. Dit kan lewensstyl siektes veroorsaak in latere lewe en ‘n verdere las op ‘n reeds verswakte gemeenskap plaas. Toepaslike intervensies, gemik op die eerste duisend dae van lewe, behoort ‘n prioriteit te wees in hierdie gemeenskap.

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ACKNOWLEDGEMENTS

I would like to thank the following persons and institutions:

My study leaders, **Dr ME van Stuijvenberg, Mrs LM du Plessis** and **Mrs SE Schoeman** for their constant motivation, guidance and advice

The **Medical Research Council** for their financial support

The **personnel** of Abraham Esau Hospital, Calvinia for their support and allowing me the time to do the research, as well as assisting in the execution there of

Dr CJ Lombard from the Biostatistics Unit of the Medical Research Council for his advice on the statistical analysis of the data

Mrs R Laubscher from the Biostatistics Unit of the Medical Research Council for analysing the dietary data

Prof M Faber from the Medical Research Council for sharing her expertise on the assessment of dietary intake in young children

Mrs M Barlow from the Medical Research Council for all the administrative support

My **husband, family** and **friends** for their unconditional support

CONTRIBUTIONS BY PRINCIPAL RESEARCHER AND FELLOW RESEARCHERS

The principal researcher, Jana Nel, developed the idea and the protocol. The principal researcher planned the study, undertook data collection, captured the data for analyses, analysed the data with the assistance of the supervisor (Dr ME van Stuijvenberg) and statistician (Dr CJ Lombard) interpreted the data and drafted the thesis. Dr ME van Stuijvenberg, Mrs SE Schoeman and Mrs LM du Plessis (Supervisors) provided input at all stages and revised the protocol and thesis.

Chapter 1

General introduction

1.1 PROBLEM STATEMENT

A cross-sectional study conducted in 2008 by the Nutritional Intervention Research Unit (NIRU) of the South African Medical Research Council (MRC) in a Northern Cape pre-school population showed that despite high levels of poverty, stunting and underweight, vitamin A deficiency (VAD) was virtually absent in this community.[1]

An adequate intake of vitamin A plays a major role in reducing the morbidity and mortality rate amongst pre-school children.[2] Dietary diversification is, in theory, the preferred approach to combat VAD. Results from the above mentioned study, suggested that this absence of VAD in Calvinia West, the community in the Northern Cape where the study was conducted, could be due to the frequent consumption of sheep liver. In this area, sheep farming is the main industry and liver is available at low cost and a local favourite food.[1] Liver intake and its contribution to vitamin A intake of the children in this community has, however, never been quantified. There was also no quantified information on the energy, protein and micronutrient intake, as well as no information on other factors, that may contribute to the poor anthropometric status of these children.

Since VAD is usually associated with poor anthropometric and low socio-economic status [2,3,4] this Northern Cape situation indicated a paradox and needed further investigation into liver intake, as well as other factors, that may contribute to the nutritional paradox of adequate vitamin A and poor anthropometric status in this community.

1.2 STUDY AIM AND OBJECTIVES

The aim of the research study described in this thesis was to examine the factors that may influence the vitamin A and anthropometric status of 24-59-month-old children from this Northern Cape community.

Specific objectives

- To determine socio-economic status of the household (Chapter 4 and Chapter 5)
- To quantify the intake of liver and liver products of the children (Chapter 4)
- To obtain information on the history of vitamin A supplementation of the children (Chapter 4)
- To establish if there was an association between liver intake and socio-economic status and education level of the mother (Chapter 4)

- To quantify the intake of energy, macronutrients and micronutrients of the children (Chapter 5)
- To establish the anthropometric status of the mothers and their children (Chapter 5)
- To obtain anthropometric profiles of the children at birth (Chapter 5)
- To obtain information on current and previous alcohol use and smoking habits of the mothers, especially during pregnancy (Chapter 5).

1.3 THESIS OUTLINE

A review of literature on vitamin A, the deficiency thereof and strategies to overcome this deficiency, as well as an overview on anthropometric status and malnutrition indicators, especially stunting, are given in Chapter 2. The study population and area is described in Chapter 3. Chapter 4 and 5 are written in article format. Chapter 4 describes one part of the study done to evaluate the contribution of liver to the vitamin A intake of 24-59-month-old children from this impoverished Northern Cape community. Factors associated with stunting in this same community are described in Chapter 5. Chapter 6 covers a general discussion of results of the research, concludes the thesis and gives further recommendations.

1.4 REFERENCES

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3. Mahan KL, Escott-Stump S. Krause's Food, Nutrition, and Diet therapy,10th ed 2000; 70-74.
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Chapter 2

Review of the literature

This review starts by describing the importance and requirements of vitamin A, which will be followed by a closer look at vitamin A deficiency (VAD), the prevalence thereof and how it can be addressed. An excessive intake of vitamin A may also have side effects and will be discussed in short.

In addition anthropometric measurements and the role it plays in assessing a population's nutritional status will also be covered. Particular attention will be paid to stunting and its risks and consequences.

2.1 VITAMIN A

2.1.1 The importance of vitamin A

Vitamin A, a fat soluble vitamin, is essential for the health of all humans, especially in children as it plays a vital role in ensuring adequate growth and development. Adequate intake of vitamin A in infants and children is also important to ensure normal vision and normal function of the body's immune system.[1]

2.1.2 Requirements and sources of vitamin A

Vitamin A intake is measured in International Units (IU) or microgram retinol equivalents (µg RE). This vitamin is found in food in two forms and therefore the unit µg RE was developed to measure these two forms in a standardised way. Retinol, the active form of the vitamin, also called pre-formed vitamin A, is only found in animal products. Animal products high in pre-formed vitamin A (retinol) include liver, milk (including breastmilk), and eggs. Pro-vitamin A (β-carotene or carotenoids) found in plants; achieve vitamin A activity once converted to retinol in the body. These foods include orange fruits and vegetables and dark green leafy vegetables.[1] Recent research indicated that 12µg β-carotene from a mixed diet, instead of 6µg β-carotene converts to 1µg RE and therefore a new standardised unit, the retinol activity equivalent (RAE) is now being used.[2] For the purpose of this study, the µg RE will be used as the South African Food Composition Tables still expresses vitamin A intake in µg RE. It will have no implication for the results of this study, because for preformed retinol, found in animal products, µg RE will be equal to µg RAE.[2] One µg RAE is equal to 3.33IU vitamin A activity from retinol.[1]

The Dietary Reference Intakes (DRIs) for vitamin A are indicated in Table 2.1.[2,3] The Estimated Average Requirement (EAR) for the pre-school child ranges between 210 and 275µg RE per day.

Table 2.1: Dietary Reference Intakes (DRIs) for vitamin A (RE) [2,3]

Gender	Age	EAR[a]	RDA[b]	AI[c]	UL[d]	NOAEL or LOAEL[e]
	Years	µg/day	µg/day	µg/day	µg/day	µg/day
Male/Female	1 – 3	210	300	-	600	-
	4 – 8	275	400	-	900	-

[a] Estimated Average Requirement
[b] Recommended Dietary Allowance
[c] Adequate intake
[d] Upper level
[e] No observed adverse effect level (NOAEL) or Lowest observed adverse effect level (LOAEL)

Table 2.2 lists the vitamin A content of some vitamin A-rich foods of which sheep liver contains an exceptional high amount of vitamin A.[4,5]

Table 2.2: Food sources rich in vitamin A [4,5]

Food sources of pre-formed vitamin A / carotenoids	Portion size	Vitamin A content (µg RE)
Liver, sheep	1 portion (90g)	7 025
Liver, chicken	2 livers (60g)	2 948
Orange fleshed sweet potato	½ cup (145g)	3 164
Milk, human (mature breast-milk)	600ml	384
Milk, full fat	1 glass (250ml)	118
Egg, chicken, whole	1, large (50g)	33
Carrot	½ cup (52g)	1 498
Spinach	½ cup (90g)	737
Squash, butternut	½ cup (105g)	349
Mango	1, small (350g)	231

2.1.3 Assessment of vitamin A intake

Different methods can be used to determine dietary intake and to assess the intake of specific nutrients, such as vitamin A.[6]

2.1.3.1 24-hour recall method

The 24-hour recall is a method which gathers data on an individual's dietary intake during the previous 24-hours. A single 24-hour recall can be used to determine the mean or median intake of a population, provided the sample size is large enough (n≥50). Multiple 24-hour recalls will be more representative of the habitual intake of the individual. The different 24-hour recalls should be distributed over week and weekend days in order to account for variations in intake during these periods.[6]

During questioning, the individual interviewee is asked for a complete list of foods and drinks consumed during the previous 24 hours, where after the foods should be specified in more detail. The intake of all foods should then be quantified by using food models, household utensils, as well as memory aids. Lastly, the 24-hour recall should be reviewed with the interviewee to ensure that all foods consumed were listed.[6]

The 24-hour recall method has been used during national nutrition surveys in various countries as it is an inexpensive and quick dietary recall method for literate, as well as illiterate individuals. When the 24-hour recall method is used in children, it is important to interview the caregiver or person responsible for the child's food intake and/or preparation. Other members of the family can also be helpful as they can help the respondent recall the previous day's intake.[6]

The 24-hour recall can both underestimate [7] and overestimate [8] nutrient intake.

2.1.3.2 Food frequency questionnaire

The food frequency questionnaire (FFQ) consists of a list of specific food items and questions regarding intake of these food items over an extended, but defined, timeframe. This includes foods in which the researcher has interest in and that might be missed in methods covering a short time period. In a FFQ where portion sizes are indicated, the data can be converted to energy and nutrient intake.[6]

2.1.4 Vitamin A deficiency

Vitamin A deficiency (VAD) is a global health problem and results in millions of preventable deaths of children under five years of age. VAD is usually associated with low socio-economic and poor anthropometric status.[1,9,10]

2.1.4.1 Causes of vitamin A deficiency

The reasons for VAD can be divided into basic, underlying and immediate causes (Figure 2.1).

The main immediate causes are insufficient intake of animal foods (preformed vitamin A), especially in developing countries, as well as low bio-efficacy, of dietary ß-carotene from plant foods.[11]

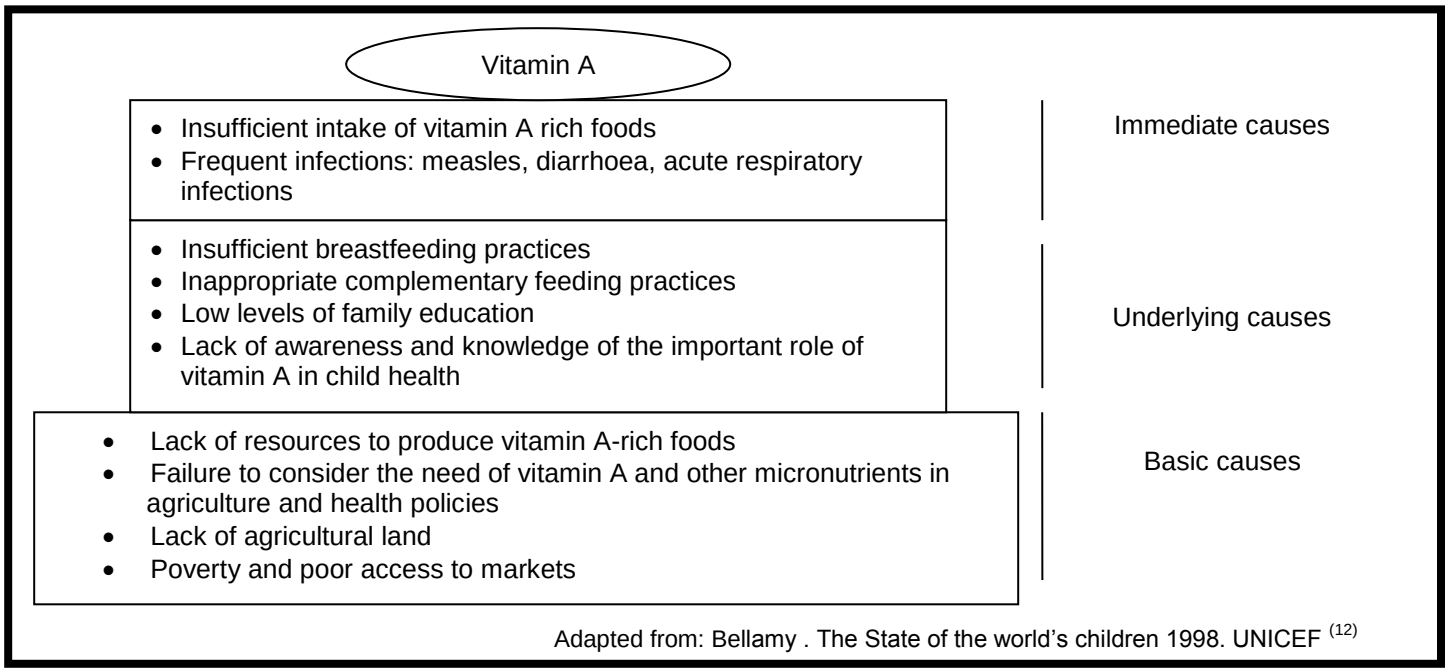


Figure 2.1: Reasons for vitamin A deficiency

2.1.4.2 Consequences of vitamin A deficiency

One of the earliest signs of VAD is night blindness which can lead to structural eye damage and scarring, xerophthalmia and eventually partial or total blindness if untreated. An increase in the number and severity of infections, especially measles, are commonly seen in children with VAD. Diarrhoea and infections presenting in children with VAD, can result in a poor appetite with subsequent weight loss and severe growth faltering.[1,9]

The vitamin A status of both infants and their mothers play an important role in child survival.[13] A meta-analysis which included eight clinical trials conducted in developing countries, where clinical signs of VAD were present, indicated that mortality rates were reduced by an average of 23% in children, six months to five years, just by supplementing them with vitamin A.[14]

It is widely accepted that protein energy malnutrition is associated with a deficiency of vitamin A, iron and iodine. Children with a compromised anthropometric status thus usually also present with VAD. [15]

2.1.4.3 Assessment of vitamin A deficiency

Vitamin A deficiency is assessed biochemically by determining concentrations of retinol in plasma or serum, and clinically by examining the child for eye signs. Serum retinol levels of <20µg/dl (<0.70µmol/l) indicates VAD and values <10µg/dl (0.35µmol/l) represents severe vitamin A deficiency. Even though night blindness and Bitot's spots are considered mild stages of eye disease, they both represent moderate to severe systemic VAD.[9] Vitamin A deficiency is regarded as a public health problem if more than 15% of the pre-school population in a country has serum retinol concentrations <20µg/dl.[16]

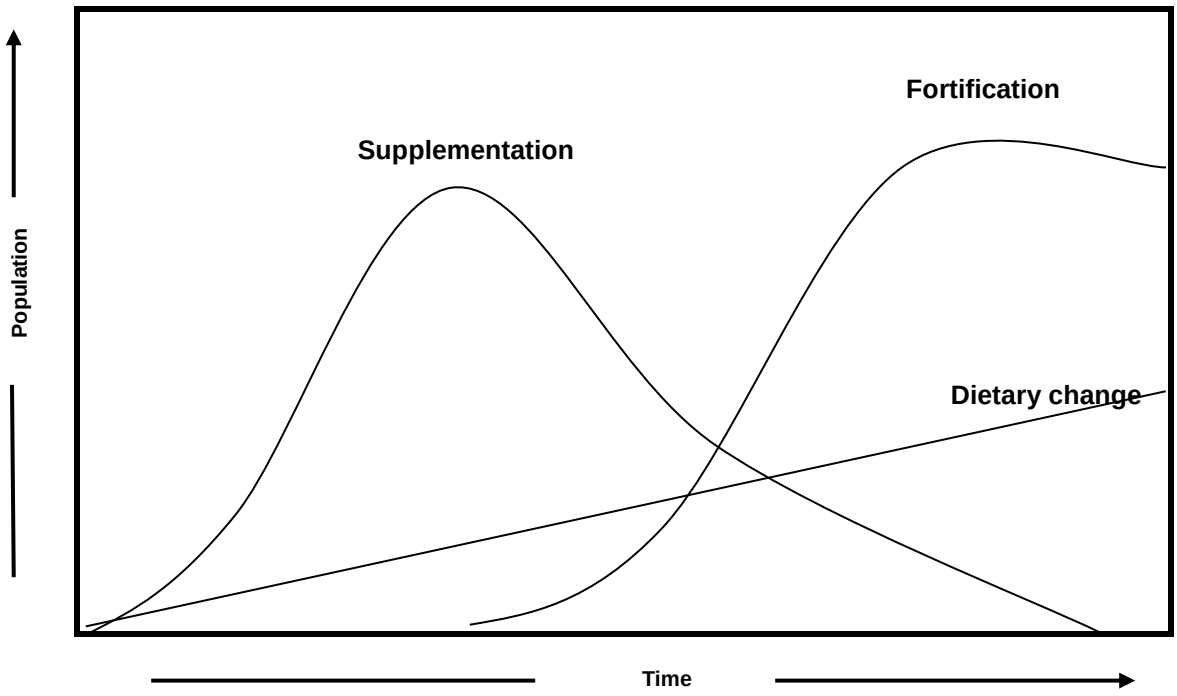
2.1.4.4 The prevalence of vitamin A deficiency

In 2002 it was estimated that worldwide 127 million pre-school children were affected by VAD, and that 4.4 million suffered from xerophthalmia.[17] According to The World Health Organization (WHO), VAD was a moderate to severe public health problem in 122 countries, based on serum retinol levels and in 45 countries, based on the prevalence of night blindness during the period 1995-2005.[9] In 2009 it was found that globally, an estimated 190 million pre-school children were affected by VAD.[18]

The 1994 South African Vitamin A Consultative Group (SAVACG) found that 33% of South African children (aged 6-71 months) had VAD based on biochemical values, even though eye signs were uncommon. The prevalence ranged from 18.5% in the Northern Cape Province to 43.5% in the Northern Province.[15] The 2005 National Food Consumption Survey Fortification Baseline (NFCS-FB-I) study showed that VAD was even more prominent with 63% of children (1-6 years) with serum retinol concentrations <20µg/dl. The Northern Cape Province again had the lowest percentage of children with vitamin A concentrations of <20µg/dl.[19]

2.1.4.5 Global approaches to eradicate vitamin A deficiency

There are three main global strategies to address VAD, i.e. high dose supplementation, food fortification and dietary diversification (Figure 2.2). A combination of these strategies, together with public health measures to reduce poverty and increase food accessibility, is considered to be the best approach for the eradication of micronutrient deficiencies.[10]



Adapted from "Forum on Food Fortification, Ottawa", Canada, 1995

Figure 2.2: The three main strategies to eradicate vitamin A deficiency

Supplementation with vitamin A: Supplementation, by means of periodic mega doses of vitamin A, is the most direct and immediate approach to control VAD and can be used for both prevention and treatment. In populations where VAD is a public health problem, prophylactic doses of vitamin A, to infants and young children, aged 6-59 months, have been proven to be one of the most cost effective interventions and is also culturally acceptable and feasible. Even though this strategy is widely used, it is regarded as a short term solution.[10,20] The role of vitamin A in childhood mortality is believed to be a function of the child's vitamin A status, and therefore not dependant on the periodic administration of high doses of vitamin A if vitamin A status is adequate.[14] A national blanket vitamin A supplementation programme targeting pre-school children from low socio-economic communities was introduced in South Africa in 2002 (Table 2.3) in response to the findings of the national nutrition survey of 1994.

Table 2.3: The South African National protocol for vitamin A supplementation [21]

Target groups	Dosage	Schedule
Non-breastfed infants 0-5 months	50 000IU	One single dose
Infants 6-11 months	100 000IU	One single dose
Children 12-59 months	200 000IU	Repeat every 6 months
Postpartum women	200 000IU	Once in the 6-8 weeks following delivery

The WHO set out new recommendations for the supplementation of vitamin A in 2011 where the mega dose for postpartum women and infants 0-5 months were omitted.[22] These new guidelines were adopted and implemented by the South African National Department of Health in August 2012.[23]

Several limitations in the implementation of the vitamin A supplementation programme were identified in a study done in 2005 in the Boland/Overberg region, Western Cape. Mothers and caregivers did not take their children for regular clinic visits after 18 months which made it difficult to administer 6 monthly vitamin A dosages. Most mothers were unaware of the vitamin A supplementation programme and therefor did not ask for their children to be supplemented, when visiting the clinic. Staff shortages and out of stock of vitamin A capsules were also reported. In the cases where vitamin A was administered, documentation thereof was found to be poor. Recording is necessary to establish if a child is due for vitamin A supplementation and to prevent overdosing. All vitamin A supplementation administered should have been recorded in the clinic records, as well as on the child's Road to Health Chart (RtHC), but only 21% (n=44) of the nursing practitioners interviewed did record it on the RtHC.[24]

Fortification of food: Food fortification, by adding vitamin A to foods, which does not normally contain vitamin A, serves as a medium to long term strategy and requires little to no effort from the target population. Although food fortification can be relatively inexpensive, sustainable and effective it needs constant monitoring and can be a challenge in countries where a food processing industry is not well established.[10] In South Africa all wheat flour, as well as maize meal, have been fortified with vitamin A and a series of other micronutrients from October 2003.[25]

Food based approaches: Dietary diversification is considered a long term intervention and is applied through educating communities on the implementation of food gardens, as well as to increase their intake of Vitamin A rich foods.[17] Sustained breastfeeding practices by mothers with adequate vitamin A stores, serve as the best protection to infants during the complementary feeding years and also act as a food based approach. Although dietary diversification is considered the ideal approach in the eradication of VAD, a multi-sectoral approach is necessary which is influenced by food availability, economic indicators and poverty. If the above mentioned strategies are not met by the health system of a country, this approach may not be a feasible or sustainable option.[10]

A systematic review of interventions on the nutritional status of children found that the impact of agricultural interventions addressing micronutrient deficiencies remained unclear. Some evidence suggested a positive impact on vitamin A, but more studies need to be done to confirm this.[26]

The Medical Research Council (MRC) together with the Agricultural Research Council (ARC) introduced household food gardens in three provinces in the 1990's to establish if the cultivation of food, rich in vitamin A, can increase the intake thereof. It was found that the intake of orange fleshed sweet potato, a rich source of vitamin A, of children two to five years, did indeed improve the intake and would presumably also have had an impact on serum retinol levels.[27]

Public health programme interventions: Together with these three main strategies described above, other public health and nutrition programme interventions to control the effects of VAD, include: the promotion of breastfeeding, family planning to space the birth of children, the use of oral rehydration therapy to treat diarrhoea and a higher coverage of immunisation to prevent measles.[6]

2.1.5 Excessive intake of vitamin A

Side effects caused by an excessive intake of vitamin A are not uncommon. Apart from transient side effects such as headache, nausea, vomiting, fever, diarrhoea and the bulging of the anterior fontanel from a single high dose vitamin A supplement in infants, toxicity may occur in individuals who frequently consume vitamin A supplements or food high in preformed vitamin A, such as liver.[28,29] Toxicity usually occurs where 30 000µg RE/100 000IU vitamin A per day, is consumed for months or years. Symptoms of long term toxicity of vitamin A can include weight loss, fever, headache, bone abnormalities, an enlarged liver, as well as raised intracranial pressure.[3]

Recently there has been a growing concern about the acute and chronic effects of asymptomatic sub-clinical toxicity of vitamin A.[29] The intake of preformed sources of vitamin A in developed countries often exceeds the recommended dietary allowance (RDA) for adults, and an intake of preformed vitamin A of only twice the current RDA has been associated with osteoporosis and hip fractures.[29] The long term effects of vitamin A sub-toxicity on health and well-being, however, need further investigation.

A study done in The Gambia, to determine the effectiveness of the higher dose supplementation schedule recommended by the International vitamin A Consultative Group (IVACG) in 2002 to the current WHO supplementation guideline, recommended that caution should be taken in supplementing with too high doses of vitamin A. Supplementing with mega doses of vitamin A in pre-school children reduces mortality, but has inconsistent outcomes on morbidity. Tailoring of vitamin A supplementation for different environments might therefore be beneficial.[30]

2.1.6 Recommendations for safely addressing vitamin A deficiency

Breastfeeding, protection against infections, food gardens and the production and consumption of local vitamin A rich foods are affordable and sustainable recommendations to address VAD.[31]

The WHO recommendation for the supplementation of vitamin A is as follows: "High-dose vitamin A supplementation is recommended in infants and children 6–59 months of age in settings where vitamin A deficiency is a public health problem."[32] The dietary intake of populations should thus be considered and investigated to determine whether all communities in a country are vitamin A deficient before "blanket approaches" are instituted.

2.2 ANTHROPOMETRIC STATUS

2.2.1 Anthropometric measurements

Anthropometric or body measurements of e.g., weight and height are internationally recommended for the assessment of malnutrition and are defined as: "measurements of the variations of the physical dimensions and the gross composition of the human body at different age levels and degrees of nutrition."[33]

Anthropometric measurements can be used for the assessment of the nutritional status in both populations and individuals. In populations, anthropometry is used as a screening tool to identify reasons and consequences of malnutrition, to conduct nutritional surveillance and to assess the outcomes of interventions. In individuals the role of anthropometry is to assess chronic imbalances of protein and energy and to diagnose overweight and failure to thrive in children. It is a simple and safe method and can be done with inexpensive equipment.[6]

2.2.2 Anthropometric assessments

In children, height-for-age (HA), weight-for-age (WA) and weight-for-height (WH) are the three indicators most commonly used. These indices can be expressed as Z-scores, percentiles, or percent-of-median, and allow for comparison of a child or a group of children with a reference population.[6,34]

2.2.2.1 Weight-for-age (WA)

WA indicates body mass relative to age. It is influenced by both the weight and height of a child and is therefore a combination of HA and WH, which makes it difficult to interpret. Underweight is a low WA at less than -2 standard deviations (SD) of the World Health Organization (WHO) international growth standards. This can be used to reflect on an individual or population's long term nutritional status, but can also be an indication of severe acute weight loss due to disease.[35]

2.2.2.2 Weight-for-height (WH)

WH reflects on body mass relative to height. It describes severe weight loss usually due to disease or a shortage of food and is used to determine the impact of severe weight loss in emergency settings. Wasting is a low WH at less than -2 SD of the WHO international growth standards.[35]

2.2.2.3 Height-for-age (HA)

The indicator, HA, is used to determine a child's linear growth achieved during the pre- and postnatal periods. Stunting is a low HA at less than -2 SD of the median value of the WHO international growth standards. It refers to a deficit in growth due to a result of poor diet or disease. A HA of less than -3 SD is defined as severe stunting.[35] In this thesis emphasis will be placed on stunting as an anthropometric indicator of concern.

2.2.3 Anthropometric classifications

Stunting, underweight and wasting are all indicators which can describe a population's nutritional status. Table 2.4 shows the classifications for assessing the severity of the above mentioned indicators.

Table 2.4. Classification for assessing severity of malnutrition by prevalence ranges among children under 5 years of age.[36]

Indicator	Severity of malnutrition by prevalence range (%)			
	Low	Medium	High	Very high
Stunting	< 20	20-29	30-39	≥ 40
Underweight	< 10	10-19	20-29	≥ 30
Wasting	< 5	5-9	10-14	≥ 15

2.2.4 The prevalence of malnutrition in South Africa

According to the 2005 South African NFCS-FB-I study the national prevalence of stunting, underweight and wasting in 1-9-year-old children was 18%, 9.3% and 4.5%, respectively. The Northern Cape province had the second highest prevalence of stunting (27.7%), but the highest

prevalence of underweight (38.3%) and wasting (19.1%).[19] According to the WHO classification (Table 2.4) this indicate severity levels of “very high” for underweight, “very high” for wasting and “medium” for stunting.[6.34]

In 1998, it was estimated that 226 million children worldwide were stunted, in 2000, 182 million children and in 2010, 171 million children, which indicated a downward trend in the global prevalence of stunting.[35,37]

According to the 1994 survey undertaken by SAVACG, 23.5% of children 12-59 months old had a HA <-2SD.[15] The 1999 National Food Consumption survey (NFCS) showed that stunting in children was still present in 25.5% of children 1-3 years old and 21% of children 4-6 years. The Northern Cape had the highest prevalence of stunting (31%).[38] These results were obtained by using the National Centre for Health Statistics (NCHS) references. In 2005, 18% of the children 1-9 years old in South Africa were stunted.[19] The data obtained from the 1999 NFCS were re-analysed and it was found that the prevalence for stunting was higher (20.1%) using the WHO 2006 references than previously indicated.[39]

The 2005 data has not been re-analysed with the WHO growth standards and it is therefore difficult to compare the results of this survey with results of the previous surveys, and to observe trends. However, it is evident that South Africa has a low to medium prevalence of stunting, with variations between the different provinces.

2.2.5 Factors associated with stunting

Stunting and underweight in children are common in developing countries with low socio-economic conditions. Intra uterine growth retardation (IUGR), poor breastfeeding practices, incorrect complementary feeding practices, poor food handling hygiene and micronutrient deficiencies, such as zinc, iron and vitamin A are all nutritional causes of growth faltering which contribute to stunting and underweight. Infectious diseases which also play a role in stunting and child development include intestinal parasitic infestations and diarrhoeal diseases.[6,12,40]

Low birth weight, large household size and early introduction of complementary feeds also contributed significantly to 2-24-month-old South African children from rural Limpopo and urban Gauteng, being stunted.[41] Male children are also more likely to be stunted.[42,43]

2.2.5.1 The effect of socio-economic status on stunting

The socio-economic status of a household adversely affects household income and food security. The 2005 NFCS-FB-I, showed the national unemployment rate in women (16-35 years) to be 85%. Half of the children in South Africa, aged 1-9 years, lived in households where the monthly income was generated by only one person and in 25% of these households the monthly income was less than R500.[19] In a study done in Johannesburg and Soweto, it was found that the likelihood of a child being stunted decreased significantly if the biological mother of the child was employed, the father completed secondary school and if the family employed a domestic worker.[42]

A study conducted in rural Limpopo and urban Gauteng found that households where stunted children were present were significantly larger than households with no stunted children.[41]

According to the 2005 NFCS-FB-I, nationally, 51.6% of the households questioned experienced hunger, 28.2% was at risk of hunger and only 20.2% of the households were food secure. The Northern Cape Province had the second highest percentage of households experiencing hunger at 65.3% (n=49). It was also shown that more than 70% of households who spent on average R200 or less on food per week experienced hunger while children living in households at risk of hunger had poorer anthropometric status.[19]

2.2.5.2 Maternal factors associated with stunting

The high prevalence of low birth weight (<2 500g) in developing countries, due to IUGR, may have significant long term consequences on body size, composition and muscle strength later in life. Most of these children cannot compensate for the prenatal growth retardation and will be about 5cm shorter and 5kg lighter in adulthood.[44] This was confirmed by the study done in rural Limpopo and urban Gauteng where a significant association was made between low birth weight and stunting.[41]

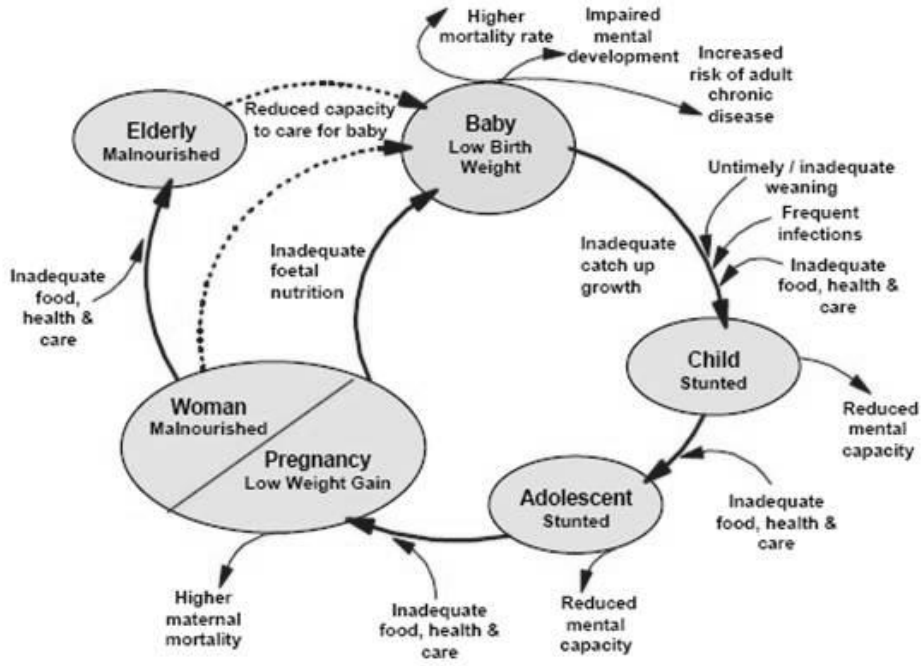
An inadequate maternal nutritional status before conception, short maternal stature, inadequate dietary intake and substance use during pregnancy, diarrhoeal disease and intestinal parasitosis also contribute to IUGR.[35,45] Alcohol use during pregnancy does not only affect a child's behaviour and cognitive function, but can also have a negative effect on the child's appetite.[45]

2.2.6 The consequences of stunting

A study done in Peru showed that stunting had a severe impact on late childhood cognitive function. Children who were stunted in their second year of life had a 10 point lower intelligence quotient at age nine than those who were not.[46] A study done in the Philippines on more than 2000 urban children

found that children who were severely stunted at age two had significant lower intelligence test scores at age eight and 11, than those children who were not stunted.[12] Behavioural problems were also found to be evident in stunted and malnourished children.[47] Stunting can also be dangerous in women as it can lead to death while giving birth due to obstructed labour.[48]

Stunting has a major impact on children's potential and should be prevented.[12] Figure 2.3 indicates the impact of various contributing factors to malnutrition, including stunting, on the life cycle. A baby born with a low birth weight never reaches full potential unless intervention takes place.



Anon. 2006. Achieving food security. What next for sub-Saharan Africa? Id21 insights, April 2006; Number 61.

Figure 2.3: The poverty malnutrition gap

2.2.7 Interventions to address undernutrition

Addressing the individual factors contributing to stunting in a specific population, as well as factors contributing to maternal and infant nutrition, is ideal strategies for combating undernutrition. Understanding the knowledge and perceptions of a community on undernutrition is vital, even though in communities where adults understood the causes and consequences of undernutrition, a high prevalence of wasting and underweight were still found due to causes out of the caregivers control. [49]

A review summarised in The Lancet Series on Maternal and Child Undernturition [50] describes the latest evidence-based interventions addressing maternal and child undernutrition. The "first 1000 days of life" [51], defined as the period from conception up until 24 months, is crucial for the development of the child and it is therefore necessary to address nutrition-related outcomes which can affect both maternal and child undernutrition. Interventions which have been shown to have a positive effect on maternal nutrition in all 36 countries which formed part of the review included: iron and folate supplementation, supplementation with multi micronutrients, including iodine and calcium and the reduction of tobacco use. [52] A study done in KwaZulu-Natal, South Africa found that daily multi micronutrient supplementation together with vitamin A and zinc had a positive effect on longitudinal growth in children, who were stunted at baseline, over a period of 18 months. This was not found in children who only received vitamin A or vitamin A together with Zinc. [53] Effective interventions for new born babies, infants and young children include: the promotion of breastfeeding, maternal behaviour change on complementary feeding, supplementation and/or fortification with multi micronutrients, including zinc, vitamin A and iodine, the improvement of hand washing and hygiene practices and the treatment of severe acute malnutrition.[52]

It has been proven that weight gain during the first 1000 days of life has a positive outcome on schooling performance and linear growth, whereas growth after 24 months of age does not have the same outcome.[52]

2.3 SUMMARY

In summary it can be said that vitamin A is important for children's growth and development. South Africa has a public health problem with VAD, as well as stunting in children, warranting a full package of interventions as proposed by the Lancet Series on Maternal and Child Undernutrition. However, a previous survey and study indicated that the Northern Cape was the province with the second highest prevalence of stunting (27.7%) and the highest prevalence of underweight (38.3%) and wasting (19.1%), but with the lowest prevalence of VAD (23%).[19] This paradox warranted further investigation.

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Chapter 3

Study area and population

3.1 STUDY POPULATION

Calvinia West is a previously disadvantaged community in the Northern Cape Province, South Africa (Figure 3.1).

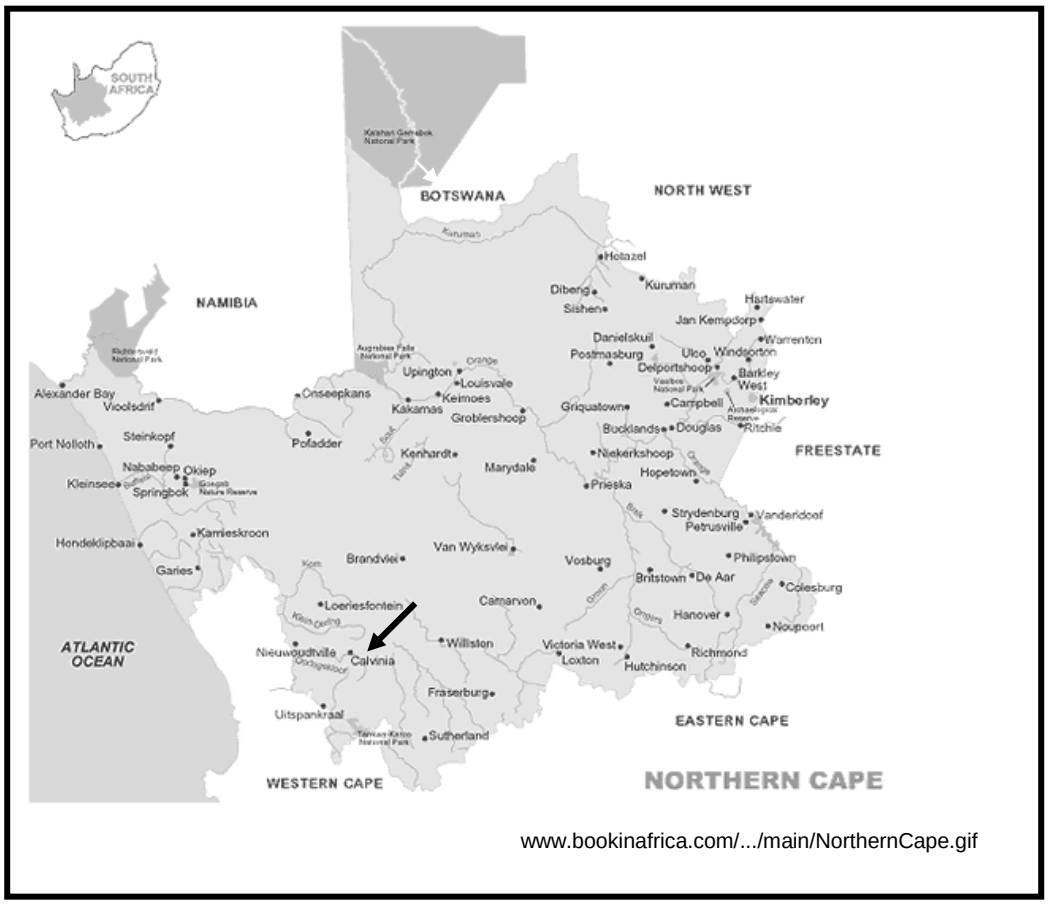

Figure 3.1: Calvinia West, Northern Cape, South Africa

The community forms part of Calvinia, a town situated in the Hantam area in the south western part of the Northern Cape. The area has a very low rainfall with extreme temperatures.

According to the 2001 national census, Calvinia had a coloured population of 6 952 of which 714 were children between birth and four years of age.[1] Most of them lived in Calvinia West.

Sheep farming is the main industry in the Hantam area and there are two abattoirs situated on the outskirts of the town. Abattoir activities take place on a daily basis which makes liver and organ meat available throughout the year. A cross-sectional study conducted by the Nutritional Intervention

Research Unity (NIRU) of the South African Research Council (MRC) found that liver was sold to the community at low cost of less than R5.00 (US$0.5) per kg liver, often through informal trading. Liver was also found to be a favourite food and was consumed by 98% of the population.[2]

3.2 VITAMIN A DEFICIENCY IN THE STUDY POPULATION

The above mentioned MRC study showed that vitamin A deficiency (VAD) was virtually absent in the Calvinia West pre-school population. None of the caregivers and only 5.8% of the pre-school children (n=243) who attended the local clinic had serum retinol concentrations <20µg/dl.[2] In 2005 the national figure for VAD was 63% in children 1–6 years. The Northern Cape had the lowest prevalence (23%) of VAD.[3]

As mentioned in Chapter 2, there are different approaches, in combination with public health programmes to address VAD, namely: high dose vitamin A supplementation, food fortification with vitamin A and dietary diversification.[4] The public health programmes and nutritional interventions in the study community are discussed below.

Public health programmes and high dose supplementation: A primary health care clinic is situated in Calvinia West, where a nutrition advisor and community service dietician render a daily nutritional service, according to the Northern Cape Department of Health's policy for at risk malnourished children and adults at health facilities. This policy addresses breastfeeding, regular de-worming and the use of oral rehydration therapy and vitamin A supplementation.[5] It is stipulated in the policy that all children above one year of age should receive a 200 000IU mega dose of vitamin A twice a year. The coverage rate for vitamin A supplementation for this age group in Calvinia clinic was 23% in August 2012.[6]

Food fortification: In South Africa all wheat flour, as well as maize meal, have been fortified with vitamin A and a series of other micronutrients since October 2003.[7] Bread is the staple food in this area, and most of the vitamin A derived via the national food fortification programme would therefore come from bread.

Dietary diversification: In a study done in Indonesia to determine the intake of vitamin A through eating orange fruits and green leafy vegetables, it was found that food gardens had a positive effect on vitamin A intake.[8] Since Calvinia West is situated in an area with arid conditions, it makes the growing of home food gardens almost impossible. The town is also far away from markets and fresh fruit and vegetables are expensive and not delivered to stores on a daily basis. Dietary diversification

is, in theory, the preferred approach to combat VAD. Results of a study done by NIRU of the MRC suggested that the frequent consumption of sheep liver in this area contributed to the low prevalence of VAD.[2]

3.3 STUNTING IN THE STUDY POPULATION

The 2005 South African National Food Consumption Survey Fortification Baseline (NFCS-FB-I) study, found the national prevalence of stunting, underweight and wasting in 1-9-year-old children to be 18%, 9.3% and 4.5% respectively. In this diverse country, the Northern Cape was the province with the second highest prevalence of stunting (27.7%) and the highest prevalence of underweight (38.3%) and wasting (19.1%).[3] In a recent study done in Calvinia West it was found that the prevalence of stunting was even worse at 40.5%. Of the children who participated in the study 23.1% were underweight and 8.4% were wasted.[2] A prevalence of stunting in more than 40% of a population indicates a “very high” prevalence and a severe problem.[9]

In the research that follows, the contribution of liver to the vitamin A intake of this population was investigated, as well as the factors that may contribute to the high levels of stunting, in this population.

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Chapter 4

The contribution of liver to the vitamin A intake of 24-59-month-old children from an impoverished Northern Cape community

(To be submitted to the South African Journal of Clinical Nutrition)

4.1 ABSTRACT

Objective: To assess the contribution of liver, the national food fortification programme and the national supplementation programme to the vitamin A intake of 24-59-month-old children from an impoverished community where liver is regularly consumed.

Design: Cross sectional, descriptive study with analytical components.

Setting: Calvinia West, Northern Cape, South Africa

Subjects: Biological mothers (n=150) and their children aged 24-59 months (n=150) living in Calvinia West from 6 months of age or younger.

Methods: A general interviewer-administered questionnaire, a 24-hour recall and an adjusted food frequency questionnaire, focussing on vitamin A rich foods, were used in the data collection process. Anthropometric measurements (weight and height) were also performed.

Results: Despite low socio-economic circumstances, liver was consumed in 92.7% (n=139) of the households and 84.7% (n=127) of the children in the households surveyed, ate liver. Some, 6.7% (n=10) more than once a week. The children, who consumed liver, had an average portion size of 65.9g (SD=36.7) at a time. The mean intake of vitamin A per day, through food, was 946.9µg RE (SD=2577.2). The national food fortification programme provided an additional 80.21µg RE (SD=62), and the national vitamin A supplementation programme another 122.1µg RE (SD=159.1) to the children's vitamin A intake. In all three age categories, liver alone supplied more than the Estimated Average Requirement (EAR) for vitamin A (210-275µg RE per day) of the children in this age group. Stunting, underweight and wasting were prevalent in 36.9% (n=55), 25.5% (n=38) and 12.1% (n=18) of children, respectively

Conclusion: Despite high levels of undernutrition in children in this impoverished community, their dietary vitamin A intake was more than optimal. Even though national data indicate vitamin A deficiency, some pockets may exist, as in Calvinia, where natural eating habits of the population protect them against this deficiency. A blanket approach, as stipulated in the national vitamin A supplementation programme, may therefore not be appropriate in this community and other communities with similar dietary intake of vitamin A.

4.2 INTRODUCTION

Vitamin A deficiency (VAD) amongst vulnerable groups is a global health problem, resulting in millions of preventable deaths of children under five years of age. VAD is usually associated with low socio-economic and poor anthropometric status.[1,2,3] According to The World Health Organization (WHO), an estimated 190 million pre-school children, globally, are affected by VAD.[2]

The 1994 South African Vitamin A Consultative Group (SAVACG) found that 33% of South African children (aged 6–71 months) were vitamin A deficient based on serum retinol concentrations <20µg/dl, even though eye signs were uncommon. The prevalence ranged from 18.5% in the Northern Cape to 43.5% in the Northern Province.[4] The more recent 2005 National Food Consumption Survey – Fortification Baseline (NFCS-FB-I) showed that VAD was even more prominent, with 63% of children (1-6 years) having serum retinol concentrations <20µg/dl. The Northern Cape Province again had the lowest prevalence of children (23%) with vitamin A deficiency.[5]

The three main global strategies to address VAD are high dose supplementation, food fortification and dietary diversification. A combination of these strategies, together with public health measures to reduce poverty and increase food accessibility, is considered to be the best approach in the eradication of vitamin A deficiency.[3] In South Africa, there are currently two blanket approaches implemented at national level: the national vitamin A supplementation programme [6] and the national food fortification programme.[7] According to the vitamin A supplementation programme, all children between the ages 6 and 59 months are scheduled to receive a high dose vitamin A supplement every six months. A single mega dose of 200 000 International units (IU) vitamin A is considered to be adequate to protect the 12-59-month-old child against vitamin A deficiency for four to six months.[8] The vitamin A content of the child's diet and the rate of utilization of vitamin A by the body determines the interval at which vitamin A is needed.[9] Vitamin A is stored mostly in the liver and this storage capacity helps to buffer against changes in vitamin A intake and avoids risks of deficiency during periods of low intake.[1] The food fortification programme was introduced in 2003 and requires wheat flour and maize meal to be fortified with micronutrients, which includes vitamin A.[7]

Dietary diversification is a long term intervention and is considered the ideal and most sustainable solution for the eradication of micronutrient deficiencies, including that of vitamin A. However, dietary diversification takes a long time to implement and to show the desired effects, as it involves educating communities and families to increase their intake of Vitamin A rich foods, as well as promoting the cultivation of these foods.[2]

A recent study in an impoverished Northern Cape community, showed only 5.8% of the pre-school children to be vitamin A deficient (serum retinol <20µg/dl) [10], which is in sharp contrast to the national prevalence of 63.6%.[5] None of the children in this study had received a high dose of vitamin A supplement during the six months prior to the study, as they were either due for their next dose of vitamin A, or their mothers/caregivers had not taken them to the clinic for their previous biannual dose. The virtual absence of vitamin A deficiency in this community was found despite high levels of stunting and underweight, and probably due to the frequent consumption of sheep liver, a food source high in vitamin A.[10] Liver intake in this population had, however, not been quantified to date.

The aim of this study was to assess the contribution of liver to the vitamin A intake of the 24-59-month-old children from this low socio-economic Northern Cape community. The contribution of the national food fortification programme and the national vitamin A supplementation programme to vitamin A intake was assessed as secondary aims.

4.3 METHODS

4.3.1 Study population and design

This was a cross sectional study of 150 children (aged 24-59 months) and their mothers living in Calvinia West, the previously disadvantaged section of the town Calvinia, which is situated in the Hantam district of the Northern Cape province. According to the 2001 national census, Calvinia had a coloured population of 6 952, of which 714 were between birth and 4 years.[11] Most of them lived in Calvinia West. Sheep farming is the main industry in the Hantam area and there are two abattoirs situated on the outskirts of the town where slaughtering takes place on a daily basis.

A map was obtained from the local municipality and all households were visited. To be included in the study, children had to be aged 24-59 months and living in Calvinia West from 6 months of age or younger. The caregiver had to be the biological mother of the child. All residents who were willing to participate in the study and who fitted the inclusion criteria were eligible for inclusion. Only one preschool child aged 24-59 months per household were included even though the mother might have had more than one child in this age group. In these households convenient sampling was applied, i.e. choosing the child that was available, or the child whose age would ensure equal distribution across age categories. Of the mother/child pairs selected to partake in the study, 28 mothers were not interested, three were under the influence of alcohol at more than one visit, and one mother moved to another area after an appointment was made for an interview. Collection of data took place between May 2010 and August 2011.

4.3.2 Ethics approval

Ethics approval was obtained from the Committee for Human Research, Faculty of Medicine and Health Science, Stellenbosch University (Ref nr: N10/03/068). The purpose of the study was explained to all mothers and they were informed that all information supplied to the researcher will be treated as confidential; that information will be used for this study only; that reference will be made to the study population and not individuals; that a unique identification code will be used for each mother/child pair; and that all documentation where names were used will be seen by the researcher only. This was conveyed verbally, as well as via a written informed consent form.

4.3.3 Socio-demographic information

All data were collected by the researcher by means of an interviewer-administered questionnaire to the mother of the child. Interviews were done in the local language, Afrikaans. The questionnaire included information on household size and income, time-period the participant had been residing in the study area, the availability of food and the education level and employment status of the mother.

4.3.4 Information on vitamin A supplementation

Information on vitamin A supplementation (dosages and dates), received at the clinic, was obtained from the Road to Health Chart (RtHC) and local clinic records (where possible). Only the vitamin A supplements received during the 6 months prior to the assessment date were used for the purpose of calculating the vitamin A intake received via supplementation programme. In line with the Northern Cape Department of Health, children aged one to five years receive a six monthly dose of 60 000µg RE (200 000 IU) vitamin A.[12] The daily dose was calculated by dividing the µg RE vitamin A by the number of days (n=183) in 6 months. Assessment took place over a period of 15 months, which included children who received a mega dose of vitamin A during the 2010 campaign, as well as those who did not.

4.3.5 Assessment of vitamin A intake

Vitamin A intake was assessed by means of a single 24-hour dietary recall, which was completed for each participating child by interviewing the mother of the child, or the person that was responsible for feeding and/or preparing the child's food on the previous day. All food and drinks that were consumed during the previous day, as well as portion sizes, were recorded. Food models and household utensils were used to determine portion sizes. The 24-hour recall was used to calculate total vitamin A intake, the vitamin A intake derived from liver, as well as the amount of vitamin A, received via the fortification programme. An adapted food frequency questionnaire, focussing on the intake of liver and liver products, was completed to obtain information on liver intake, which might have been missed by the

24-hour recall method. This included frequency of liver consumption, portion size, as well as the age, at which liver was introduced into the child's diet. Each food item obtained by the 24-hour recall and adapted food frequency questionnaire was coded by using the MRC Food Quantities Manual [13] and Condensed Food Composition Tables for South Africa [14] and was analysed to obtain the daily nutrient intakes, using the 2010 updated SAFOODS database.[15] All dietary assessments and coding were done by the researcher, a registered dietician.

4.3.6 Assessment of anthropometrical status

Weight of the child was measured to the nearest 0.05kg, using an electronic load cell scale (UC-321 Personal Precision Health Scale, A&D Company, Ltd, Tokyo, Japan). The scale was placed on a flat, hard surface. Measurements were done in light clothing and without shoes. The average of 3 measurements were calculated and recorded. The scale was calibrated daily with an object of a known weight.

Height was measured in a standing position, using a portable SECA 214 Leicester Height measure (Invicta Plastics Limited, Oadby, Leicester, LE2 4 LB, England).

The head was in the Frankfurt plane position, the feet together and the knees straight. Measurements were taken without shoes or hat, to the nearest 0.1cm. The average of 3 measurements was recorded. All measurements were taken in privacy at the time of the interview.

Height-for-age, weight-for-age and weight-for-height z-scores were calculated using the WHO growth standards [16] and the software programme, Anthro Plus.

4.3.7 Statistical analysis

Data were analysed using the IBM SPSS statistical programme (SPSS Inc., IL, USA, version 19). Continuous data were expressed as means (SD) or medians (25^{th}; 75^{th} percentile) and categorical data were reported as percentages. The Mann-Whitney U test was used to compare liver intake of the higher socio-economic categories with that of the lower socio-economic categories. P-values below 0.05 were considered statistically significant.

4.4 RESULTS

The study population consisted of 150 mother and child pairs. The characteristics of the children and mothers are displayed in Table I. The mean age of the children was 3.5 years (SD=0.89), with the children equally distributed over age and gender categories. Stunting, underweight and wasting were prevalent in 36.9% (n=55), 25.5% (n=38) and 12.1% (n=18) of children, respectively. The mean age of the mothers was 30 years, ranging between 17 and 49 years. The majority of the mothers (85%; n=128) had been living in Calvinia West for more than ten years, with 65.3% (n=98) having lived there all their lives. Only 25.3% (n=38) of the mothers completed high school, while 27.3% (n=41) had seven years or less of schooling; none had any higher qualification. Almost a quarter (24.7%; n=37) of the mothers were employed at the time of the study and 36% (n=54) worked within the 12 months prior to the study. None of the mothers were employed in a professional capacity and 13.3% (n=20) did labour where no skill was needed. The average income per household per month was R3381 (SD=2881) with 14.1% (n=21) having a monthly income of R1000 or less and only 14.8% (n=22) an income of more than R5500.

Table I: Characteristics of the children and mothers participating in the study (n=150)

	Mean (SD)	N	Proportion (%)
Children			
Age (years)	3.53 (0.89)		
2.0-2.9		53	35.3
3.0-3.9		46	30.7
4.0-4.9		51	34.0
Boys/girls		77/73	51.3/48.7
Anthropometric status (n=149)			
Stunting*		55	36.9
Underweight**		38	25.5
Wasted§		18	12.1
Mothers			
Age (years)	30.07 (7.56)		
< 25		49	32.7
25-29.9		34	22.6
30-34.9		22	14.7
35-39.0		24	16.0
≥ 40		21	14.0
Years having lived in this community	23.5 (10.3)		
< 5 years		8	5.3
5-10 years		14	9.4
> 10 years		128	85.3
Proportion of life in this community (%)	79.8 (29.9)		
Education level			
Grade 1-3		2	1.3
Grade 4-7		39	26
Grade 8-11		71	47.4
Grade 12		38	25.3
Higher qualification		0	0
Type of employment			
Professional		0	0
Skilled		13	8.7
Semi- skilled		21	14.0
Unskilled		20	13.3
Unemployed during past 12 months/student		96	64
Total household income per month (n=149)	R3381 (2881)		
< R1000		18	12.1
R1000 – R2499		54	36.2
R2500 - R5499		55	36.9
≥ R5500		22	14.8

*Height-for-age, **weight-for-age, §weight-for-height. Z-scores < -2 SD of the WHO reference media.

Liver was consumed in 92.7% (n=139) of the households and by 84.7% (n=127) of the children participating in the study. Sixty eight percent (n=102) consumed liver at least once a month, while 14.7% (n=22) consumed liver once a week or more. An average portion size, of the children who consumed liver, was reported to be 65.9g (SD=36.7) at a time, with 22.8% (n=29) of the children eating more than 100g of liver at a time. Liver was introduced into the children's diet at a mean age of 18.5 months (SD=8.8), and 49.6% (n=63) of the children have been eating liver from the age of 12 months or younger (Table II). No seasonal effect on liver intake was reported. Liver was very available and was mostly bought at the local abattoir shop at an affordable price.

Table II: Liver consumption patterns of study population (n=150)

	Mean (SD)	**N**	**Proportion (%)**
Households consuming liver		139	92.7
Preschool children consuming liver		127	84.7
Frequency of liver consumption by child per month (n=150)	1.66 (2.16)		
Never		23	15.3
< 1 x per month		25	16.7
1 x per month		55	36.7
2-3 x per month		25	16.6
4 x per month		12	8.0
> 4 x per month		10	6.7
Portion size eaten by child (g) (n=127)*	65.9 (36.7)		
< 30		13	10.2
30-59		42	33.1
60-99		43	33.9
≥ 100		29	22.8
Age at which liver was introduced into child's diet (months) (n=127)	18.5 (8.8)		
< 12		11	8.7
12		52	40.9
18		8	6.3
24		43	33.9
36		12	9.4
48		1	0.8

* portion size calculated only for those who consumed liver

There was a significant (p=0.028) inverse association between the amount of liver intake and household income (Table III). Liver intake was also significantly (p=0.016) higher in the children whose mothers were unskilled as opposed to those with skilled mothers. Although not significant, children of mothers who did not complete grade 12 tended to eat more liver. Older mothers introduced liver into the child's diet at a younger age. There was no association between the number of years that the mother have lived in Calvinia and liver intake.

Table III: Relationship between socio-demographic factors and liver intake

Factor	N	Frequency of liver consumption (times per month)	Portion size (g)	Amount of liver per month (g)	Age at which liver was introduced (months)
Educational level of mother					
< Grade 12	112	1.7 (2.2)	65.7 (36.1)	121.3 (173.9)	18.6 (8.5)
≥ Grade 12	38	1.4 (1.9)	66.6 (39.3)	105.5 (186.0)	18.1 (9.7)
p-value		*NS*	*NS*	*NS*	*NS*
Type of employment					
Unskilled/unemployed/ student	137	1.8 (2.2)	66.5 (36.4)	124.7 (181.9)	18.8 (8.9)
Skilled	13	0.6 (0.6)	56.9 (41.9)	39.2 (66.7)	15.1 (7.0)
*p-value**		*p=0.017*	*NS*	*p=0.016*	*NS*
Household income					
< R5500	127	1.8 (2.3)	67.9 (36.9)	128.5 (186.8)	18.6 (8.8)
≥ R5500	22	1.0 (1.2)	51.7 (33.2)	57.8 (80.9)	18.0 (9.0)
p-value		*p=0.075*	*p=0.083*	*p=0.028*	*NS*
Income per household size					
< R1000	129	1.8 (2.3)	65.6 (36.8)	127.5 (185.9)	18.5 (8.8)
≥ R1000	20	0.75 (0.93)	67.5 (37.4)	57.2 (79.8)	18.4 (9.2)
p-value		*p=0.009*	*NS*	*p=0.046*	*NS*
Age of mother (years)					
≤ 35	105	1.7 (2.4)	64.5 (36.6)	117.1 (178.2)	19.6 (8.4)
> 35	45	1.5 (1.6)	68.7 (37.2)	117.8 (174.6)	16.2 (9.2)
p-value		*NS*	*NS*	*NS*	*p=0.016*

*p-value comparing the two categories, using the Mann-Whitney U test

NS = not significant

Table IV shows the vitamin A intake derived from liver, food fortification and vitamin A supplementation, respectively. The mean total vitamin A intake per day, according to the 24-hour recall, was 946.9µg RE (SD=2577.2). The mean intake of vitamin A derived from liver, according to the 24-hour recall, was 1.6 times higher than the mean vitamin A intake measured by the liver frequency questionnaire (537 vs 325µg RE). Median intake according to the 24-hour recall was zero. The national food fortification programme provided 80.21µg RE (SD=62), and the national vitamin A supplementation programme an additional 122.1µg RE (SD=159.1).

Table IV: Vitamin A intake derived from liver, food fortification and supplementation in the 24-59-month-old children from the Calvinia West community

	Mean (SD)	**Median (25^{th}; 75^{th} percentile)**
Total vitamin A intake (µg RE) – 24-hour recall	946.9 (2577.2)	269 (175.9; 449.5)
Vitamin A derived from liver (µg RE)		
- 24-hour recall (n=149)	537.0 (2516)	0.0 (0.0; 0.0)
- Liver frequency questionnaire (n=150)	325.3 (491.3)	146.4 (48.8; 390.3)
Vitamin A derived from the National Food Fortification Programme - bread and maize meal (µg RE) – 24-hour recall	80.21 (62.0)	65.4 (34.0; 100.8)
Vitamin A derived from the National Vitamin A Supplementation Programme (µg RE)*** -** RTHC	122.1 (159.1)	0.0 (0.0; 328.0)

* Supplementation was calculated for only those 137 children who had a RtHC available. Of these children, 37.2% (n=51) received 60 000µg RE during the past 6 months i.e., 328µg RE per day (60 000/183 days); 86 children did not receive a supplement during the past 6 months, thus the per capita average for the group was 122.1µg RE and not 328µg RE per day.

The contribution of liver, food fortification and vitamin A supplementation to the vitamin A intake of the child per age category are shown in Figure 1. In all three age categories, liver alone supplied more than the Estimated Average Requirement (EAR) of the child, but tended to be highest in the 3-3.9-year-old age category. The contribution of fortification was the highest in the older children (4-5 years), while the contribution of the supplementation programme was the highest in the 2-2.9 year age group

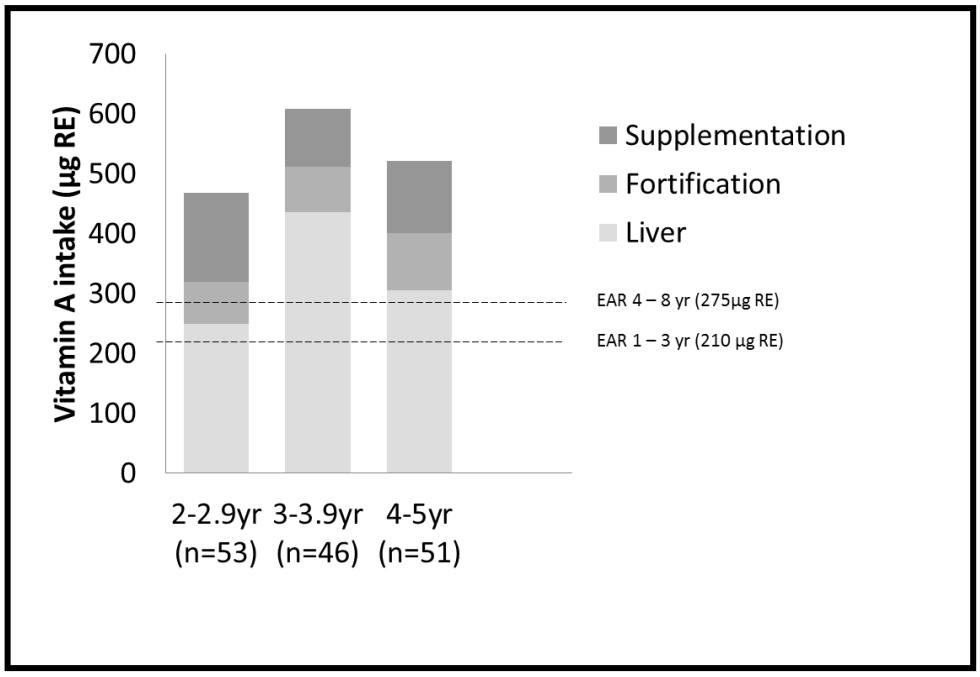

Figure I: The contribution of liver, food fortification and vitamin A supplementation to the vitamin A intake of the child per age category per day.

4.5 DISCUSSION

This study aimed to assess the contribution of liver to the vitamin A intake of pre-school children in an impoverished Northern Cape community where vitamin A deficiency was previously shown to be virtually absent. Liver is frequently eaten in this area, but had not been quantified before. The results of the present study showed that liver intake alone contributed to more than 100% of the EAR for vitamin A of the pre-school children.

Liver, mostly in cooked or fried form, was eaten by almost all of the children, with the majority eating liver at least once per month, and some as often as once a week or more. The average portion size of the children, who consumed liver, was 66g at a time. Liver is an excellent source of preformed vitamin A and a 70g portion of liver contains 5 464µg RE vitamin A.[17] The EAR for the pre-school child ranges between 210 and 275µg RE vitamin A per day.[18] A daily intake of foods, rich in vitamin A, is

not needed to maintain homeostasis, as vitamin A is stored in the liver which ensures that it is used when needed during times of low intake.[1] A 70g portion of liver will thus ensure adequate vitamin A levels for a 26 day period in a 1-3-year-old child and for a period of 20 days in a 4-8-year-old child.

Liver intake was assessed by both the 24-hour recall method and a liver frequency questionnaire. The mean intake of vitamin A from liver, according to the 24-hour recall, was 1.6 times higher than the vitamin A intake measured by the liver frequency questionnaire. The 24-hour recall can both underestimate [19] and overestimate [20] nutrient intake, since intake during the previous 24 hours is not necessarily representative of the habitual intake of an individual. In this study, the 24-hour recall gave an overestimation of the mean vitamin A intake derived from liver, when compared to the liver frequency questionnaire. This is because of the exceptional high vitamin A content of liver, and the fact that 8 children (5.4%) ate liver on the previous day. Conversely, because liver is on average only eaten once or twice a month, liver intake could have easily been underestimated or entirely missed by using only the 24-hour recall method, even should the multiple 24-hour recall method have been used. Using the median to express vitamin A intake, would not have given an accurate reflection of vitamin A intake either, because the majority of the children (95%) did not eat liver the day before, which resulted in the median vitamin A intake from liver to be zero. Thus, in populations where liver is eaten, neither the *mean* or *median* intake of vitamin A, according to the 24-hour recall, would give an accurate reflection of liver consumption, and hence vitamin A intake.

It can be assumed that the 24-hour recall, even though it was only one recall per child, gave a good reflection of the children's intake of staple foods, and thus the vitamin A intake derived from the national fortification programme (i.e. 80µg RE). This is a low socio-economic community that, from observation, followed a monotonous diet with little variety. Both weekdays (75.8%) and weekend days (24.2%) were represented in the assessments. Bread is a staple food in the area, and a sample size of 150 would have been large enough to reflect the mean consumption thereof.

The national vitamin A supplementation programme contributed an additional 122µg RE per day. In line with the Northern Cape Department of Health, children aged one to five years receive a six monthly dose of 200 000IU (60 000µg RE) vitamin A, which would, in theory, provide 328µg RE per day.[12] To improve the coverage of the vitamin A supplementation programme, the National Department of Health held a vitamin A supplementation campaign in May 2010, where all children received a 200 000IU dose of vitamin A, unless a mega dose was given in the two months prior to the campaign. If all the children partaking in the study were assessed within six months of the May 2010

vitamin A campaign, the mean intake via the supplementation programme for the group as a whole would have been closer to 328µg RE per day.

Vitamin A deficiency is usually associated with low socio-economic status.[2,3] In this community, it was found that mothers who were unskilled or unemployed, fed their children liver more often than the skilled mothers. Furthermore, in households where the monthly income was less than R5500, the liver intake was significantly higher than in households where the income exceeded R5500. Although not significant, there was a trend of higher intake of liver in those households where the mother did not complete school. This suggested that the households that are socio-economically more vulnerable, consume more liver, and are therefore less likely to be vitamin A deficient. This is in contrast to the general assumption that poor socio-economic status and vitamin A deficiency goes hand in hand, [2] but is in line with the results of the previous study in this community which showed a significant inverse correlation between educational level of the caregiver and the frequency of liver intake at household level.[10]

Sheep farming is the main agricultural activity in this area and with two abattoirs in town, where organ meat can be obtained at a shop close to the community and at a relatively low price, sheep liver is an affordable source of meat for the poor. Children eat liver from an early age. This community's unique eating habits naturally protect them against vitamin A deficiency, making other interventions with regard to vitamin A unnecessary. However, a concern is the fact that in 15% of the children the vitamin A intake from liver alone, according to the liver frequency questionnaire, exceeded the Tolerable Upper Intake Level (UL) for their respective age categories (i.e., 600µg RE for children 1-3 years, and 900µg RE for children 4-8 years [18] and could put them at risk of excessive vitamin A intake. This does not take into account the contribution from the national food fortification and national vitamin A supplementation programmes, which on average provided an additional 80µg RE and 122µg RE, respectively. Too much vitamin A is known to be harmful. [21] Apart from acute side effects from a single high dose vitamin A supplement in infants, [22] toxicity may also occur due to a frequent consumption of vitamin A supplements or foods high in preformed vitamin A, such as liver.[23] The effects of subclinical toxicity of vitamin A in children that are otherwise malnourished is also not known, especially with regard to bone health.[21,24] Long-term intake of excessive vitamin A in adults has been linked to osteoporosis and hip fractures.[21]

The South African (SA) food composition database, [15] used to calculate the daily intake of vitamin A, expresses vitamin A intake in µg retinol equivalents (µg RE), which assumes that 6µg of dietary ß-carotene is needed to produce 1µg retinol. However, the bio-conversion of ß-carotene from plant

foods is less than previously thought, and 12µg ß-carotene from a mixed diet is now thought to be necessary to produce 1µg retinol.[18] The 2001 Dietary Reference Intake (DRI) takes the new conversion factor into account and expresses vitamin A requirements in terms µg retinol activity equivalents (µg RAE). In this study, the vitamin A intake from plant foods would thus have been overestimated. This, however, would not have had an effect on the intake of preformed vitamin A intake derived from liver, the food fortification programme or the national vitamin A supplementation programme, for which 1µg RAE is equivalent to 1µg RE or 1µg retinol.[18]

A strength of the study is that all measurements and interviews with study participants were done by the researcher, a registered dietician, who lives and works in the area and is familiar with the cultural background and habits of the study population.

4.6 CONCLUSION

Without vitamin A supplementation or the consumption of fortified food, most children would still have received adequate vitamin A from the intake of liver alone, which makes this an area where a food based “approach” to protect against VAD is already in place, without health authorities having had to intervene. It was also concluded that the 24-hour recall method is not suitable for communities where liver is frequently consumed, as vitamin A is stored in the liver and does not have to be eaten daily. An 80-100g portion of liver is enough to ensure adequate vitamin A for four weeks in the preschool child. To obtain a more accurate reflection of vitamin A intake in such communities, a food frequency questionnaire, focussing on the intake of liver, should be used in conjunction with the 24-hour recall method. The results of this study also challenge the notion generally held by international health bodies, such as the WHO, that low socio-economic status and vitamin A deficiency go together.[2,3]

The impact of dietary diversification on micronutrient deficiencies was recognized by the WHO as one of the three main global strategies to address such deficiencies. In communities with a high habitual consumption of foods containing vitamin A, food fortification and high dose supplementation may actually cause a higher intake than anticipated. Even though national data indicate VAD, some pockets may exist in South Africa where the inherent eating habits of the population protect them against this deficiency, and may actually act as a coping mechanism in the socio-economically more vulnerable. Blanket interventions by the government may do more harm than good in such instances as it provides vitamin A availability over a long period of time. A targeted approach with regard to the national vitamin A supplementation programme may therefore be a more appropriate way to combat vitamin A deficiency in a country with a diverse population and diverse eating habits.

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Chapter 5

Factors associated with stunting in 24-59-month-old children in an impoverished community in the Northern Cape Province

(To be submitted to the South African Journal of Clinical Nutrition)

5.1 ABSTRACT

Objective: To assess factors associated with stunting of 24-59-month-old children from an impoverished community.

Design: Cross sectional, descriptive study with analytical components.

Setting: Calvinia West, Northern Cape, South Africa

Subjects: Biological mothers (n=150) and their children aged 24-59 months (n=150) living in Calvinia West from 6 months of age or younger.

Methods: A general interviewer-administered questionnaire and a 24 hour-recall were used in the data collection process. Anthropometric measurements (weight and height) were also performed for both mothers and children.

Results: Stunting was found to be present in 36.9% (n=55) of the children which is double that of the national figure. The prevalence of low birth weight (<2 500g) was also found to be double that of the estimated figure for Southern Africa.

Only 11.4% (n=17) of the mothers were underweight with a body mass index (BMI) of less than 18.5kg/m^2, while as many as 46.3% (n=69) were either overweight or obese. Of the mothers 26.2% (n=39) were stunted.

A significant correlation was found between various indicators of poor socio-economic status (i.e. income, household size, whether the mother was skilled or not, possessing a vehicle or fridge) and height-for-age Z-scores ($p<0.01$).

Conclusion: Low socio-economic circumstances, incorrect complementary feeding practices, low birth weight of the child and substance use by the mother during pregnancy all had a significant impact on this poor anthropometric status of the child. Stunting is a result of poverty which is a social issue requiring long term interventions such as the creation of employment and better educational systems. In order to address this huge problem, resources and interventions have to be focussed on the first 1000 days of life.

5.2 INTRODUCTION

Stunting and underweight in children are common in developing countries with low socio-economic conditions and are often used as an indicator for the nutritional status of a population.[1] The effects of stunting are long term and may have a severe impact on late childhood cognitive function and behaviour.[2,3] In 2001 it was estimated that stunting affected 33% of all children under the age of five years in developing countries and as many as 50% of children in lesser developed countries. [4] In 2010 it was estimated that as much as 171 million children worldwide were stunted.[5]

According to the 1994 survey undertaken by the South African Vitamin A Consultative Group (SAVACG), 23.5% of South African children 12–59 months old were stunted.[6] The 1999 National Food Consumption survey (NFCS) showed that stunting was still present in 25.5% of children aged 1-3 years, and in 21% of children aged 4-6 years. In this survey the Northern Cape province presented with the highest prevalence of stunting (31%).[7] The South African National Food Consumption Survey (NFCS-FB-I) of 2005 indicated that the national prevalence of stunting, underweight and wasting in 1-9-year-old children was 18%, 9.3% and 4.5% respectively, with the Northern Cape province having the second highest prevalence of stunting (27.7%) and the highest prevalence of underweight (38.3%) and wasting (19.1%).[8]

The high prevalence of intra uterine growth retardation (IUGR) in developing countries, resulting in a low birth weight (<2 500g), may have irreversible long-term consequences on body size and composition.[9] An inadequate maternal nutritional status before conception, short maternal stature, inadequate dietary intake and smoking during pregnancy are the major contributing factors to IUGR.[9] Alcohol use during pregnancy does not only affect a child's birth weight, but can also have a negative effect on the child's behaviour, cognitive function, appetite and thereby also growth.[10]

Low socio-economic conditions adversely affect household income and food security leading to poor growth and anthropometrical status. Poor breastfeeding and complementary feeding practices, poor food handling hygiene and micronutrient deficiencies, such as zinc, iron and vitamin A are nutritional causes of growth faltering which contribute to stunting and underweight. Infectious diseases, intestinal parasitic infestations and diarrhoeal diseases also contribute significantly to children aged 2-24 months, being stunted and underweight.[1,11,12,13]

This knowledge about factors that influence a child's growth and development, from the time of conception until the second birthday, also known as the first thousand days of life, have led to

increasing evidence that interventions aimed at this period provides the most important window of opportunity for nutrition interventions.[14]

A study conducted by the Nutritional Intervention Research Unit (NIRU) of the South African Medical Research Council (MRC) in 2008, in an impoverished Northern Cape community showed that 40.5% of the 1-6-year-old children were stunted, 23.1% underweight and 8.4% wasted.[15] This prevalence of children with stunted growth was almost double the national prevalence, and also higher than the prevalence in the Northern Cape province, where the community is situated.

The aim of the present study was to identify the factors that may have contributed to the high prevalence of stunting amongst the 24-59-month-old children in this low socio-economic Northern Cape community.

5.3 METHODS

5.3.1 Study population and design

This was a cross sectional study of 150 children (aged 24-59 months) and their mothers living in Calvinia West, the previously disadvantaged section of the town Calvinia, which is situated in the Hantam district of the Northern Cape province. According to the 2001 national census, Calvinia had a coloured population of 6 952, of which 714 were between birth and 4 years.[16] Most of them lived in Calvinia West. A map was obtained from the local municipality and all households were visited. To be included in the study, children had to be aged 24-59 months and living in Calvinia West from the age of 6 months or younger. The caregiver had to be the biological mother of the child. All residents who were willing to participate in the study and who fitted the inclusion criteria were included. Only one preschool child aged 24-59 months per household were included, even though the mother might have had more than one child in this age group; in these households convenient sampling was applied, i.e. by choosing the child that was available, or the child whose age would ensure equal distribution across age categories. Of the mother/child pairs selected to take part in the study, 28 mothers were not interested, three were under the influence of alcohol at more than one visit, and one mother moved to another area after an appointment was made for an interview. Data collection took place between May 2010 and August 2011.

5.3.2 Ethics approval

Ethics approval was obtained from the Committee for Human Research, Faculty of Medicine and Health Science, Stellenbosch University (Ref nr: N10/03/068). The purpose of the study was explained to all mothers and they were assured that all information supplied to the researcher would

be treated as confidential; that information would be used for this study only; that reference would be made to the study population and not individuals; that a unique identification code would be used for each mother/child pair; and that all documentation where names were used would be seen by the researcher only. This was conveyed verbally, as well as via a written informed consent form.

5.3.3 Socio-demographic information

All data were collected by the researcher by means of an interviewer-administered questionnaire to the mother of the child. Interviews were done in the local language, Afrikaans. The questionnaire included information on household size and income, marital status, education level and employment status of the mother, availability of food, as well as breastfeeding patterns, and current source of milk for the infant.

5.3.4 Assessment of dietary intake

A single 24-hour dietary recall was completed for each participating child by interviewing the mother of the child, or the person that was responsible for the child's food preparation and feeding. All food and drinks that were consumed during the previous day, as well as portion sizes, were recorded. Food models and household utensils were used to determine portion sizes. Each food item was coded by using the MRC Food Quantities Manual [17] and Condensed Food Composition Tables for South Africa [19] and was analysed to obtain the daily nutrient intakes, using the 2010 updated SAFOODS database.[19] All dietary assessments and coding were done by the researcher, a registered dietician. Intakes were expressed as a percentage of the Estimated Average Requirement (EAR). Where an EAR was not available, the Estimated Energy Requirement (EER) (for energy), the Recommended Dietary Allowance (RDA) (for protein and carbohydrate) or the Adequate Intake (AI) (for fibre) were used.[20]

5.3.5 Assessment of anthropometric status

Weight of the mother and child was measured to the nearest 0.05kg, using an electronic load cell scale (UC-321 Personal Precision Health Scale, A&D Company, Ltd, Tokyo, Japan). The scale was placed on a flat, hard surface. Measurements were done in light clothing and without shoes. The average of 3 measurements was recorded. The scale was calibrated daily with an object of a known weight.

Height was measured in a standing position, using a portable SECA 214 Leicester Height measure (Invicta Plastics Limited, Oadby, Leicester, LE2 4 LB, England). The subject stood with the head in

the Frankfurt plane position, with the feet together and the knees straight. Measurements were taken without shoes or hat, to the nearest 0.1cm. The average of 3 measurements was recorded.

Privacy was ensured by taking all measurements inside the participant's dwelling. All measurements were taken at the time of the interview. Information on the child's birth profile was obtained from the Road to Health Chart (RtHC). If the child's RtHC was not available, this information was obtained from the local hospital, where possible.

Height-for-age (HAZ), weight-for-age (WAZ) and weight-for-height (WHZ) z-scores for children were calculated using the WHO growth standards [21] and the Anthro Plus software programme.

The indicator, height-for-age (HA), is used to determine a child's linear growth. Stunting is classified as a low HA at less than -2 standard deviations (SD) of the median value of the National Center for Health Statistics/Word Health Organization (NCHS/WHO) international growth reference. A HA of less than -3 SD is defined as severe stunting.[9]

To calculate the mothers HAZ the WHO reference median for 18-year-old girls was used, assuming the mother's height had not changed since. [21] The body mass index (BMI) of mothers was calculated and is expressed as $kg/m^{2.}$ A BMI of $18.5kg/m^2$–$24.99kg/m^2$ is considered to be optimal where $<18.5kg/m^2$ is underweight, 25-$29.99kg/m^2$ overweight and $>30kg/m^2$ obese.[1]

5.3.6 Assessment of substance use

Information on current alcohol use and smoking, as well as during pregnancy, was obtained by means of an interviewer-administered questionnaire. Mothers tended to think that alcohol use were considered "to be drunk", but were not shy to admit current alcohol use, as well as alcohol use during pregnancy, when told that alcohol use were also seen as the social consumption thereof. Mothers had no hesitation on answering questions regarding their smoking habits.

5.3.7 Statistical analysis

Data were analysed using the IBM SPSS statistical programme (SPSS Inc., IL, USA, version 19). Continuous data were expressed as means (SD) or medians (25^{th};75^{th} percentile) and categorical data were reported as percentages. The Mann-Whitney U test was used to compare the nutrient intake in stunted (HAZ in lower quartile) and non-stunted children (HAZ in the upper quartile), and to compare the HAZ in children that did and did not drink milk. Pearson and spearman correlation coefficients

were used to test for correlations between variables. P-values below 0.05 were considered statistically significant.

5.4 RESULTS

The study population consisted of 150 children and their mothers. The maternal and socio-demographic information are displayed in Table I. The mean age of the mothers was 30 years, and ranged between 17 and 49 years. As many as 27.3% (n=41) of the mothers had seven years or less of schooling, and only 25.1% (n=38) completed high school. Almost a quarter of the mothers (24.7%; n=37) were employed at the time of the study, while 36% (n=54) had worked during the 12 months that preceded the study. None of the mothers were employed in a professional capacity and 13.3% (n=20) did labour where no skill was needed.

The mean number of occupants per household was 6.4 (SD=2.38), with 43.3% (n=65) of households having more than 6 occupants, and 13.3% (n=20) more than 10 occupants. Almost all of the households (90.6%; n=135) depended on a social grant as means of income, and 89% (n=134) of the households received a child grant. The average monthly income per household was R3381 (SD=2881), with 14.1% (n=21) having a monthly income of R1000 or less, and only 18.1% (n=27) an income of R5000 or more. The average amount of money available per person per month was R585 (SD=576). Some of the households, (17.4%; n=26) spent less than R200 per week on food. Most (90.6%; 136) of the participants responded that they always have enough food for everyone in the household, and 28.6% (n=43) reported that they sometimes obtain food from other sources.

Table I: Maternal and socio demographic information of the study population (n=150)

	Mean (SD)	N	Proportion (%)
Age (years)	30.07 (7.56)		
Education level			
Grade 1-3		2	1.3
Grade 4-7		39	26
Grade 8-11		71	47.4
Grade 12		38	25.3
Higher qualification		0	0
Employment status			
Currently employed		37	24.7
Employed during past 12 months		54	36.0
Type of employment			
Professional		0	0
Skilled		13	8.7
Semi- skilled		21	14.0
Unskilled		20	13.3
Unemployed during past 12 months/student		96	64
Number of people per household	6.44 (2.38)		
≤ 4		32	21.3
5-6		53	35.4
7-9		45	30.0
≥ 10		20	13.3
Sources of income (> 1 source per family possible)*			
Own income		38	25.5
Spouse's / partner's income		46	30.9
Financial support from family		62	41.6
Welfare support (grant)		135	90.6
Maintenance from father		41	27.5
Total household income per month *	R3381 (2881)		
≤ R1000		21	14.1
> R1000 – R2500		52	34.9
> R2500 - R5000		49	32.9
> R5000		27	18.1
Income expressed per household size [§]	R585 (576)		
≤ R200		26	17.4
> R200-R500		64	43.0
> R500-R1000		39	26.2
> R1000-R1500		12	8.0
≥ R1500		8	5.4

Amount of money spent on food per week	R279 (148)		
< R200		43	28.9
> R200-R499		79	53.0
≥ R500		27	18.1
Availability of food			
Always enough food for everyone in household		136	90.7
Sometimes not enough food for everyone in household		13	8.7
Most of the time not enough food for everyone in household		1	0.7
Food obtained from other sources			
Relatives		33	22.0
Neighbours / friends		3	2.0
Welfare		1	0.7
Borrow / on credit		6	4.0
Do not obtain food from other sources		107	71.3

*for questions related to income, n=149

§ The amount of money available per person per month

The mean age of the children was 3.5 years (SD=0.89), with the children equally distributed over age and gender categories. The prevalence of stunting, underweight and wasting was 36.9% (n=55), 25.5% (n=38) and 12.1% (n=18). Birth weight was low (< 2500 g) in 27.7% (n=39) of the children. Only 11.4% (n=17) of the mothers were underweight with a body mass index (BMI) of less than 18.5kg/m^2, while as many as 46.3% (n=69) were either overweight or obese.[(1)] More than a quarter of the mothers 26.2% (n=39) were stunted, using the WHO reference median for 18-year-old girls.[(21)] (Table II).

Table II: Anthropometric status of the children and their mothers (n=150)

	Mean (SD)	N	Proportion (%)
Children			
Age (years)	3.53 (0.89)		
2.0-2.9		53	35.3
3.0-3.9		46	30.7
4.0-4.9		51	34.0
Boys/ girls		77/73	51.3/48.7
HAZ	-1.56 (1.15)		
WAZ	-1.15 (1.16)		
WHZ	-0.37 (1.43)		
Stunted*		55	36.9
Underweight**		38	25.5
Wasted§		18	12.1
Birth profile¶			
Birth weight (g)	2826 (592)		
Low birth weight (< 2500g)		39	27.7
Pre-term deliveries (< 37 weeks)		14	13.1
Mothers			
Body mass index (kg/m^2)	26.42 (7.92)		
< 18.5		17	11.4
18.5 – 24.9		63	42.3
25.0-29.9		28	18.8
≥ 30		41	27.5
Height (cm)	153.9 (6.0)		
HAZ†	-1.38 (0.90)		
Stunted‡		39	26.2

HAZ=height-for-age Z-score, WAZ=weight-for-age Z-score, WHZ=weight-for-height Z-score
*HAZ, **WAZ, §WHZ < -2 SD of the WHO reference median [(21)]
¶ Information on birth weight and gestation available for only 141 and 107 children, respectively
† Height-for-age Z-scores, using the WHO reference for girls aged 18 years
‡ Height-for-age Z-scores < -2 SD of the WHO reference median for girls aged 18 years

The energy and macronutrient intake of the children are displayed in Table III. The median energy intake of the children was 4 533kJ, and was 79.5% of the EER of the respective age and gender categories. The median intake of carbohydrates and protein exceeded the DRI, whereas the median fibre intake reached only 34% of the recommended intake. Fifty five percent of the total energy intake was derived from carbohydrates, 15% from protein, 30% from fat, and 17% of the total energy intake came from added sugars.

Table III Energy and macronutrient intake of the children participating in the study (n=149)

	Mean (SD)	**Median (25^{th}; 75^{th} percentile)**	**DRI***	**% DRI** **Mean / Median**
Energy (kJ)	4713 (1330)	4533 (3575; 5721)	4688 (boys; 2y) 4487 (girls; 2y) 6216 (boys; 3y) 5839 (girls; 3y) 6555 (boys; 4y) 6174 (girls; 4y)	85.1 / 79.5
Carbohydrate (g)	151.6 (47.6)	149.1 (120.1; 177.2)	130	117 / 115
Protein (g)	42.9 (20.9)	40.5 (28.9; 52.7)	13 (1-3y) 19 (4-8y)	290 / 256
Fat (g)	38.2 (17.1)	35.5 (25.8; 49.0)	-	-
Fibre (g)	8.0 (4.1)	7.2 (5.0; 9.8)	19 (1-3y) 25 (4-8y)	38 / 34
Added sugar (g)	47.2 (27.9)	44.6 (28.7; 62.5)	-	-
Energy derived from:			% of the total energy Mean/Median	
Carbohydrate Added sugars Protein Fat			54.7 / 55.9 17.0 / 16.7 15.5 /15.2 30.0 / 29.0	

* Dietary reference Intakes (DRI): Estimated Energy Requirement (EER) was used for energy; Recommended Dietary Allowance (RDA) was used for carbohydrate and protein; Adequate Intake (AI) was used for fibre
** According to respective age and gender categories

The micronutrient intake of the children is detailed in Table IV. The median intake was at least 80% of the estimated average requirement (EAR) for all micronutrients, except for calcium, vitamin D and vitamin E, where the median intake was 21%, 15%, and 32%, respectively. The median intake of iron, zinc, niacin, vitamin B_6 and vitamin B_{12}, exceeded 200% of the EAR.

Table IV: Micronutrient intake of the children participating in the study (n=149)

Nutrient	Mean (SD)	Median (25^{th}; 75^{th} percentile)	*EAR*	% EAR* Mean / Median
Calcium (mg)	215 (199)	126 (64; 332)	*500* *800*	37 / 21
Iron (mg)	8.1 (4.8)	6.9 (5.3; 9.6)	*3.0* *4.1*	240 / 208
Phosphorous (mg)	530.0 (251.9)	489.6 (359; 679)	*380* *405*	136 / 129
Zinc (mg)	7.2 (3.9)	6.2 (4.5: 9.1)	*2.5* *4.0*	246 / 209
Magnesium (mg)	125.1 (41.7)	124.9 (94.4 ; 152.1)	*65* *110*	164 / 150
Copper (µg)	1245 (3239)	555 (431; 705)	*260* *340*	326 / 147
Vitamin A (µg RE)	946.9 (2577)	269 (180; 450)	*210* [a] *275* [b]	400 / 118
Vitamin D (µg)	2.0 (1.9)	1.5 (0.8; 2.5)	*10* *10*	21 / 15
Vitamin E (mg)	3.1 (3.2)	1.8 (1.1; 4.1)	*5* *6*	58 / 32
Vitamin C (mg)	23.7 (28.8)	16.1 (6.0; 27.6)	*13* *22*	158 / 91
Thiamin (mg)	0.85 (0.34)	0.79 (0.6; 1.1)	*0.4* *0.5*	196 / 185
Riboflavin (mg)	1.00 (1.62)	0.58 (0.32; 1.03)	*0.4* *0.5*	228 / 125
Niacin (mg)	15.2 (7.5)	14.2 (10.3; 18.8)	*5.0* *6.0*	284 / 264
Vitamin B_6 (mg)	2.44 (1.23)	2.20 (1.57; 3.21)	*0.4* *0.5*	560 / 516
Folate (µg)	169 (159)	124 (94; 185)	*120* *160*	127 / 95
Vitamin B_{12} (µg)	8.5 (29.0)	1.9 (0.9; 3.6)	*0.7* *1.0*	1019 / 249

* Percentage of the Estimated Average Requirement (EAR) according to respective age categories
[a] EAR for age 2 and 3 years; [b] EAR for age 4 and 5 years

There was a significant difference in the intake of fat, calcium, phosphorous, vitamin D, riboflavin and vitamin B_{12} between the children who were stunted (HAZ ≤ -2.26) and those who were not stunted (HAZ ≥ -0.78), and a marginally significant difference in the intake of energy and vitamin A. (Table V)

Table V: The relation between nutrient intake* and height-for-age Z-scores

Nutrients	**HAZ ≤ - 2.26 (lower quartile)** **Mean (SD) (n=35)**	**HAZ ≥ - 0.78 (upper quartile)** **Mean (SD) (n=35)**	***P-Value*****
Energy (kJ)	4378 (1193)	4800 (1067)	*0.059*
Protein (g)	36.2 (16.5)	42.9 (20.1)	*NS*
Carbohydrate (g)	152.8 (47.5)	155.8 (43.5)	*NS*
Fat (g)	31.8 (14.0)	38.6 (14.9)	*0.043*
Calcium(mg)	142.1 (140.0)	284.4 (226.9)	*0.001*
Phosphorus (mg)	429 (150)	547 (217)	*0.026*
Iron (mg)	6.6 (2.8)	7.6 (3.0)	*NS*
Zinc (mg)	6.1 (3.4)	6.5 (3.4)	*NS*
Magnesium (mg)	117.0 (35.1)	132.8 (43.3)	*NS*
Copper (µg)	0.55 (0.17)	0.56 (0.18)	*NS*
Vitamin A (µg RE)	460 (806)	413 (459)	*0.058*
Vitamin D (µg)	1.26 (1.53)	2.40 (2.38)	*0.004*
Vitamin E (mg)	2.33 (2.34)	2.76 (2.31)	*NS*
Vitamin C (mg)	16.0 (16.4)	30.3 (41.2)	*NS*
Thiamin (mg)	0.75 (0.30)	0.88 (0.33)	*NS*
Riboflavin (mg)	0.45 (0.27)	0.84 (0.52)	*0.000*
Niacin (mg)	14.0 (5.9)	15.2 (6.0)	*NS*
Vitamin B_6 (mg)	2.3 (1.3)	2.4 (1.0)	*NS*
Folate (µg)	134.2 (67.3)	147.5 (63.6)	*NS*

Vitamin B_{12} (µg)	1.5 (1.9)	2.3 (1.8)	*0.013*

*Nutrient intake according to the 24h-recall; 8 children that ate liver the previous day excluded from the analysis
**Mann-Whitney U test

More than 90% of the children (93.9%;n=141) were either being breastfed at the time of the study, or had been breastfed in the past. The children, who were breastfed, were breastfed to a median age of 24 months. Sixty three percent (n=94) of the children did not drink milk (in any form) or consumed it with food only at the time of the study. There was a significant difference in HAZ between the children who drank milk (in any form, in a cup/glass/bottle) and the children who did not drink milk, or consumed milk with food only (with porridge/in coffee) (-1.15 *vs* -1.81). (Table VI)

Table VI: Milk intake and breastfeeding history of the children participating in the study (n=150)

	Median (25^{th}; 75^{th} percentile)	**N**	**Proportion (%)**
Current source of milk			
Breastmilk		29	19.3
Formula milk		4	2.7
Cow's milk		23	15.3
Milk with food only		62	41.3
None		32	21.3
Breastfeeding history			
Currently breast-fed		29	19.3
Previously breast-fed		112	74.7
Never breast-fed		9	6.0
Duration of breastfeeding (n=112)			
< 4 months		24	21.4
4-6 months		10	8.9
> 6 months		78	69.6
Duration of breastfeeding (months)	24 (5.3;30.0)		
Milk intake in relation height-for-age Z-scores			
Milk intake	*N*	*HAZ [mean (SD)]*	
Children who drank milk	56	-1.15 (1.18)	
Children who did not drink milk*	94	-1.81 (1.07)	
*P-value***		*p=0.004*	

* Includes children that use milk with food only
** Mann-Whitney U test

Correlation coefficients for the factors that were associated with height-for-age in the children are listed in Table VII. There was a significant positive correlation (r=0.250; p=0.003) between the birth weight of the child and the child's current HAZ. The height of the mother, as well as several indicators of socio-economic status, also correlated significantly with the HAZ of the child.

Table VII: Correlation coefficients for the factors associated with stunting (HAZ < -2SD)

	Correlation coefficient (r)	**P-value**
Birth weight	0.250*	0.003
Mother's height**	0.362*	0.000
Number of people in household	-0.240*	0.003
Total income of household	0.207*	0.011
Income per person in household	0.279*	0.001
Mother skilled *vs* unskilled	0.262***	0.001
Possess motor vehicle *(20% possess a motor vehicle)*	0.296***	0.000
Possess fridge *(77.3% possess a fridge)*	0.254***	0.003

* Pearson correlation coefficient;

** No correlation was observed between the mother's height and the birth weight of the child; (r=0.099; p=0.247)

*** Spearman correlation coefficient

Smoking and alcohol use by mothers are shown in Table VIII. Of the mothers 38.7% (n=58) reported smoking while they were pregnant with the child partaking in the study, and 16% (n=24) admitted using alcohol during pregnancy. The birth weight of the children whose mothers smoked during pregnancy was significantly lower (p=0.008) than the birth weight of the children whose mothers did not smoke. Likewise, the birth weight of the children whose mothers used alcohol during pregnancy was also significantly lower (p=0.001) than the birth weight of the children whose mothers did not. Beer was the alcoholic beverage most often consumed, and amounts of as much as 3 litres were consumed at a time, even during pregnancy. No correlation was found between birth weight and the number of cigarettes or the amount of alcohol consumed.

Table VIII: Smoking and alcohol use by mothers during pregnancy and its relation to birth weight (n=150)

	N	Proportion (%)
Mothers who currently smoked	78	52.0
Mothers who smoked during pregnancy	58	38.7
Mothers who currently used alcohol	57	38.0
Mothers who used alcohol during pregnancy	24	16.0
Relation to birth weight*		
Mother smoked during pregnancy	N	*Birth weight [mean (SD)]*
Yes	54	2640.0 (586)
No	87	2941.8 (570)
P-value**		*p= 0.008*
Mother used alcohol during pregnancy		
Yes	24	2444.2 (647)
No	117	2904.6 (552)
P-value **		*p= 0.001*

*Birth weight available only for 141 children; **Mann-Whitney U test

5.5 DISCUSSION

The very high prevalence of stunting (40.5%), previously reported in this low socio-economic community in the Northern Cape province, [15] was confirmed in the present study, with 37% of the pre-school children classified as stunted. The aim of this study was to assess the possible factors associated with stunting in these children.

The socio-economic conditions in this community were found to be poor. Households consisted of extended families, while some mothers already had up to five of her own children living with her. Only a quarter of the mothers completed high school, which resulted in many of them being unemployed or doing unskilled work for a small salary. A welfare support grant was a source of income in almost all of the households. It was previously found that hunger was experienced in more than 70% of households that spend on average R200 or less on food per week [8] In this study, although a third of the households spent less than R200 per week on food, only 10% reported to not always have enough food for everyone in the household. However, a third of the mothers reported that they also at times obtained food from other sources, such as relatives or friends. A significant correlation was found between various indicators of poor socio-economic status (i.e. income, household size, whether the mother was skilled or not, possessing a vehicle or fridge) and height-for-age Z-scores (HAZ).

Poverty and poor socio-economic status are basic causes of undernutrition [11], underlying the more immediate or direct causes such as nutrient intake and/or disease.

In this study, a significant correlation was found between the birth weight of the child and the child's current HAZ, suggesting that factors impacting on the child before birth may also play a role in the development of malnutrition. The prevalence of low birth weight in this community was 28%, which is high compared to data for Southern Africa (14.6%).[22] Birth weight or intra uterine growth retardation (IUGR) is affected by the mother's environment, behaviour and practices during pregnancy. The study did not include information on the mother's nutrient intake during pregnancy, but did collect information on smoking and alcohol use, both of which is known to independently have an effect on birth weight. [9,10] In this study, birth weight was significantly lower in the children of mothers who smoked during pregnancy than in those children whose mothers did not smoke. Birth weight was also significantly lower in the children of mothers who used alcohol during pregnancy than in the children whose mothers did not. The fact that there was no correlation between birth weight and the quantity of alcohol consumption could probably be attributed to the fact that subjects tend to underreport alcohol use,[23] which makes it is very difficult to obtain accurate information on the amount of alcohol consumed. [24] The same would apply to smoking.

The median energy intake was 80% of the recommended intake, and the intake of carbohydrate, protein and fat exceeded the recommended intake. However, 17% of the total energy, even though still lower than 25%, [20] came from added sugars, which add “empty calories” to the diet. There was a marginally significant difference between the energy intake of the HAZ of children in the lowest quartile and the highest quartile. A chronic deficit in energy, together with an already low birth weight due to intra uterine growth retardation, classically leads to stunting; a picture that is seen in this impoverished community. Underweight, which is present in a quarter of the study population and wasting in more than 1 out of 10 children also points to acute episodes of low food intake and disease, which is commonly seen in low socio-economic communities.

The intake of the micronutrients conventionally linked to stunting, i.e. vitamin A, [20,25] zinc [26,27] and iron [28] was adequate. This paradox can be explained by the sheep farming environment surrounding this community, and the fact that liver, a good source of above mentioned micronutrients, especially vitamin A, is an available and affordable source of meat for the poor (discussed in Chapter 4).

However, the intake of calcium and vitamin D were found to be inadequate (median intake < 25% of the EAR). A significant difference was found in the intake of calcium, phosphorous, vitamin D, riboflavin, vitamin B_{12} and fat between children who were stunted and those who were not.

Cow’s milk is a good source of these nutrients, especially of calcium and riboflavin, but was found not to be frequently consumed in this community. Results showed that 63% of the study participants did not drink milk. Low intake of milk may thus have contributed to the high levels of stunting in this community. This is further strengthened by the fact that the HAZ was significantly higher in the children whose mothers indicated that their children routinely drink milk as opposed to those who did not drink milk, or used milk with food only. Cow’s milk has previously been shown to affect linear growth, probably via stimulation of circulating insulin-like growth factors.[29] However, the intake of calcium, riboflavin and vitamin D status has also been linked to linear growth.[30,31] Many nutrients are needed for growth, and when one growth-limiting nutrient is absent, optimal growth may not occur. Stunting in Vietnamese children for example, continue to be high despite improvement in vitamin A and iron status due to an increased intake of animal and fish products. Intake of dairy products was, however, limited and a possible link between the latter and stunting was suggested by the authors of this particular study.[32]

Stunted children may also become overweight and obese adults.[33] In this study population, 26% of the mothers were stunted, using the WHO reference median for 18-year-old girls.[21] It is therefore not

surprising that almost 50% of the mothers were either classified as overweight or obese, and therefore at risk of chronic lifestyle diseases.

In line with the WHO guidelines on breastfeeding, the Northern Cape Department of Health promotes exclusive breastfeeding until 6 months and then the introduction of appropriate complementary feeding with breastfeeding continuing up to 24 months. Breastfeeding and the correct introduction of complementary feeding has a positive outcome on child development and growth.[34,35] Breastfeeding was practiced by more than 90% of the mothers in this community. At the time of the study, 19% of the children were still being breastfed which contributed to the total of 57.3% of the children being breastfed for 24 months or longer. However, from the researcher's experience, the optimal practice of exclusive breastfeeding with the timeous introduction of safe and appropriate complementary feeding in this community is sub-optimal. Water and rooibos tea are in most cases introduced before the age of six months and coffee and bread sometimes the only complementary feeding available.

The amount of breastmilk consumed by these children was not taken into consideration with the analysis of the child's nutrient intake, as it is difficult to quantify. Taking into account that all the children in the study were at least two years old, the amount of breastmilk at that age would probably not have made a significant difference to overall nutrient intake.

A strength of the study is that all measurements and interviews were done by the researcher, a registered dietician, who lives and works in the area and is familiar with the cultural background and habits of the study population.

A possible limitation in the study is that only one 24-hour recall was used to collect dietary information. Intake of one particular day does not necessarily reflect the participant's habitual intake and does not allow for correlations between intake and other variables to be made.[36] The 24-hour recall can, however, be used to report the mean or median intake of groups. The study population comprised of 150 subjects, and where associations were made, subgroup means were used for comparisons. Furthermore, because the study population is a low socio-economic community, following a monotonous diet with little variation (personal observation), combined with the fact that both weekdays (75.8%) and weekend days (24.2%) were included in the assessments; it is likely that a fairly accurate reflection of the dietary intake in this population (except for liver) was obtained.

5.6 CONCLUSION

The aetiology of stunting is complex. Results of the study suggest that smoking and alcohol use, resulting in low birth weight, may have played an important role in the high levels of stunting in this community. Additionally, from the researcher's experience, exclusive breastfeeding practices are sub-optimal and the introduction of complementary feedings not always timeous. Poor socio-economic status underlies all of these factors. Stunting forms part of a vicious malnutrition cycle leading to children with low cognitive function. Low schooling and cognitive function in return, leads to unemployment or unskilled jobs, resulting in poverty which directly influences a child's quality of diet and hence anthropometric status.

In addition, a community where stunting is prevalent also leads to a community where overweight and obesity is prevalent. This results in diseases of lifestyle adding a further burden to an already weakened community. Poverty, which is a social issue, requires long term interventions such as the creation of employment and better educational systems.

Furthermore, in order to urgently address this huge problem of stunting, resources and interventions have to be focussed on the time period from conception up until 24 months of age as it has been proven that weight gain during the first 1000 days of life has a positive outcome on schooling performance and linear growth, whereas growth after 24 months of age does not have the same outcome.[14,37]

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Chapter 6

General discussion and conclusion

6.1 GENERAL DISCUSSION

This study aimed to examine the factors that may have contributed to the nutritional paradox of adequate vitamin A status and poor anthropometric status in 24-59-month-old children of an impoverished Northern Cape community.[1]

The study was conducted in Calvinia West, which is situated in the Hantam area in the Northern Cape province. Sheep farming is the main industry in this area and abattoir activities takes place on a daily basis. Sheep liver, which is readily available at low cost and a favourite food of the local population, is a good source of micronutrients, especially of vitamin A. In this study, it was shown that liver intake alone contributed to more than 100% of the EAR for vitamin A of the pre-school children. Liver was eaten by almost all (85%) of the children and from a young age. Being available at low cost, liver was an affordable source of meat for the poor. The results of the study showed that the lower the income and socio-economic circumstances, the higher the intake of liver, which makes this an area where the community's unique eating habits act as a "food-based approach" that naturally protects them against vitamin A deficiency.

Liver is a unique food, with a 100g portion containing 37 times the EAR for vitamin A of a 1-3-year-old child and 28 times the EAR for a 4-8-year-old child.[2] Vitamin A is stored in the liver, which ensures that there is a reserve that can be used when needed during times of low intake.[3] It is therefore not necessary to consume foods rich in vitamin A on a daily basis. Since liver is not eaten every day, and in many cases not even on a weekly basis, liver intake can easily be missed in dietary assessment using only the 24-hour recall method, which may result in an underestimation of vitamin A intake. Conversely, vitamin A intake could also be overestimated by using the 24h-recall method. This was seen in the current study where 5% of the children consumed liver the previous day, resulting in a higher mean intake of the group. It is therefore important to complement the 24-hour recall with another dietary intake method (e.g. a food frequency questionnaire) in areas where liver is eaten by a high proportion of the population.

The national food fortification programme contributed between 30% and 40% of the EAR for vitamin A. The study population is from a low socio-economic community, following a diet with little day to day variation. Both week and weekend days were included in the assessments. It can therefore be assumed that even though only one 24-hour recall was completed for each child, this method gave a

good reflection of the child's vitamin A intake obtained from the staple food in the area, and hence the national food fortification programme.

A national blanket vitamin A supplementation programme for pre-school children was introduced in 2002. [4] South Africa, however, is a diverse country consisting of a multi-cultural population with different dietary habits. The prevalence of vitamin A deficiency also varies from province to province. [5] A vitamin A supplementation programme may thus be unnecessary or inappropriate in populations where their natural dietary habits result in adequate vitamin A intake. In this community, liver intake already contributed to more than 100% of the recommended vitamin A intake of the children, and the vitamin A supplementation programme added an additional 122µg RE per day. Too much vitamin A is not without harm, and apart from acute symptoms from a single dose of vitamin A in children, [6] toxicity may also occur due to the frequent consumption of foods high in preformed vitamin A, such as liver.[7] Long-term intake of excessive vitamin A has been linked to poor bone health in adults,[8] and may also result in an increase in respiratory disease in children.[9]

The high prevalence of stunting in this population, which is double the national level [10], is a concern. Stunting in children is associated with decreased cognitive function and behavioural problems later in life, [11,12] as well as increased morbidity and mortality.[13] Stunted children may also result in overweight and obese adults[14], a trend that was also seen in this study population. Almost 50% of the mothers were either overweight or obese, and therefore at increased risk of chronic diseases of lifestyle.[15]

The high levels of stunting in these children could be due to sub-optimal intake of energy over a long period. The children's median energy intake was 80% of the Estimated Energy Requirement, and a marginally significant difference was found between the energy intake of stunted and non-stunted children. Although macronutrient intake, as well as the intake of zinc, iron and vitamin A was adequate, milk intake was low, and may also have contributed to stunting in this population. It was found that the height-for-age of children who consumed milk on a regular basis was significantly higher than the height-for-age of those who did not. Cow's milk intake has previously been shown to affect linear growth. [16]

A significant correlation was also found between the birth weight of the child and the child's current height-for-age, suggesting that factors during pregnancy also play a role in the development of malnutrition. Both smoking and alcohol use during pregnancy was inversely associated with the birth

weight of the children. All of these factors are related to poor socio-economic status, which similar to stunting form part of a vicious malnutrition cycle and associated health risks.

A limitation of the study is the lack of serum retinol values for this specific study population. The Nutritional Intervention Research Unit (NIRU) of the South African Medical Research Council (MRC) did a study in 2008 in the Calvinia West community where serum retinol levels were taken. Data from this study were used to make assumptions regarding the vitamin A status in this population.

6.2 GENERAL CONCLUSION

This study affirms the food based approach as an important strategy to address vitamin A deficiency in this community. Vitamin A requirements were met by the intake of liver alone. The results of this study challenge the notion generally held by international health bodies, such as the WHO, that low socio-economic status and vitamin A deficiency go together. In this poor community vitamin A deficiency was virtually absent, and it was the households from lower socio-economic categories that consumed liver more often.

The research described in this thesis suggested various reasons for the high levels of stunting in this community. Poor socio-economic status underlies all of these factors. To address the problem of stunting, poverty alleviation together with improved education regarding alcohol use and smoking during pregnancy should be essential long-term strategies. Apart from the immediate dangers of underweight, stunting and wasting in a community, stunting can also lead to overweight and obesity later in life, resulting in diseases of lifestyle and adding a further burden to an already weakened community. An urgent focus on appropriate, evidence-based, short and intermediate term interventions with long lasting effects, during the first thousand days of life, as described in the Lancet Series on Maternal and Infant Undernutrition, is also needed and should be made a priority.[17]

6.3 RECOMMENDATIONS

- The Calvinia community and possibly the Hantam district should not be implementing the national blanket vitamin A supplementation approach, but rather a targeted approach. This should be communicated to the National Department of Health, Directorate: Nutrition, as well as the Provincial Department of Health, Northern Cape Province, Sub-Directorate Nutrition.

- Poverty alleviation strategies, as well as improved education, should be prioritised in this community. A multi-stakeholder and interdisciplinary approach will be needed to bring this to effect.

- Interventions regarding maternal nutrition as from conception needs to be addressed. Education is needed regarding a variety diet and the dangers of smoking and alcohol use during pregnancy. The implementation of micronutrient supplementation during pregnancy should be strengthened and monitored.

- Strategies regarding infant and young child feeding, including the promotion of breastfeeding, the introduction of complementary feedings and hygiene practices, should be implemented and monitored.

6.4 FUTURE RESEARCH

- Calvinia West is a small community in a multi-cultural country. Sheep farming and the availability of sheep liver at a low cost to the community seemed to be the main reason for the virtual absence of vitamin A deficiency in this area. Future research to identify communities with similar liver eating patterns should be undertaken.

- Further investigation regarding alcohol use during pregnancy, the prevalence of foetal alcohol syndrome and its effect on child health and nutritional status in this community is recommended in order to introduce suitable intervention practices. The effect of alcohol abuse by the mother, on the child's care (i.e. food preparation and feeding), should also be investigated.

- The dietary intake of the mothers during pregnancy, especially with regard to the intake of milk, should also be investigated in this community.

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ADDENDA

Code:

Factors contributing to the vitamin A and anthropometric status of 24 to 59-month-old children from a Northern Cape community, South Africa.

General Questionnaire

1. Name of person to complete questionnaire:							
2. Date:	D	D	M	M	Y	Y	
3. Name of mother:							
4. Date of birth of mother:	D	D	M	M	Y	Y	

	Name:	Age: Years	Months
5. How many (own) children do you have? Write down the names and ages of all children and mark the child that will be used for the study.			
	Total number of children:		

6. Date of birth of child:	D	D	M	M	Y	Y

7. Sex of child:	Male[1]	Female[2]

Socio-demographic information

8. Address:						
9. How long have you been living in Calvinia:	Years	Months				
10. Marital status:	Married[1]	Living together[2]	Single[3]	Divorced/ Estranged[4]	Widowed[5]	
11. What is your highest level of education? (Note and mark corresponding block) ……	None[0]	Gr 1-3[2]	Gr 4-7[3]	Gr 8-10[4]	Gr 11-12[5]	Other[6] …….
12. Who is the head of the household?	Self[1]	Husband/partner[2]	Mother/Father[3]	Other family[4]	Other / Unrelated[5]	
13. Are you working?	Yes[1]	No[2]				
14. Have you been employed in the last 12 months?	Yes[1]	No[2]				

15. What kind of work did you do or are you doing?		
16. What is the means of income in the household?	Own income[1]	Amount
	Spouse/partner's income[2]	Amount
	Monetary help from family[3]	Amount
	Social Grant[4] (Specify)	Amount
		Amount
		Amount
		Amount
	Other income[5] (Specify)	Amount
	No income[6]	
	Total	Amount
17. How much money do you spend on food per week?		
18. If no monetary income, where does food come from?		

19. Availability of food for the household:	Always enough food for everyone in the house[1]	Sometimes not enough food for everyone (twice per month or more)[2]	Most of the time not enough food for everyone (twice per week or more)[3]	Other [4,] specify …….……

20. How many people sleep in the house for 5 or more nights in the week?	Number of adults:		
	Number of children:	0-5 years	
		5 – 12 years	
		13 – 18 years	

21. Type of dwelling	Formal house[1]	Back yard dwelling[2]	Informal structure on open field/space[3]	
22. Is the house built of:	Brick and cement[1]	Clay[2]	Tin[3]	Wood[4]
23. How many rooms does the house have: (excl: bathroom, toilet, kitchen)				

24. Where does the household usually get its drinking water from?	Tap inside the house[1]	Tap outside the house[2]	Neighbour's tap[3]	Public tap[4]	Other[5], specify ……

25. What type of fuel does the household mostly use for cooking of food?	Electricity[1]	Gas[2]	Paraffin[3]	Wood / open fire inside house[4]	Wood / open fire outside house[5]

26. What toilet facilities are available /used within the household?	Flush inside the house[1]	Flush outside the house[2]	Bucket[3]	Other[4],Specify ……..
27. Which assets does the household have? (more than one items allowed)	Fridge[1]	TV[2]	Cellphone[3]	Car[4]

Substance use			
28. Do you smoke?		Yes[1]	No[2]
29. What do you smoke?			N/A
30. How much do you smoke per day?	Cigarettes / Pills:		N/A
	Pipe:		
31. Did you smoke while you were pregnant with the child taking part in this study?		Yes[1]	No[2]
32. How many cigarettes / times per day did you smoke?			
33. Do you drink any alcohol?		Yes[1]	No[2]
34. What do you drink?			N/A

35. How often do you drink?	Every day[1]	Weekends[2]	Other[3]:	N/A
36. How much do you drink at a time?				N/A
37. Did you drink alcohol while you where pregnant with the child taking part in this study?			Yes[1]	No[2]
38. How much did you drink?				N/A

Breastfeeding patterns				
39. What type of milk is your child currently drinking? (More than one can be applicable.)	Breast milk[1]	Formula milk[2] …….....	Cow's milk[3]	Other[4] ……
40. Was the child breastfed previously?			Yes[1]	No[2]
41. Until what age did you breastfeed your child?				N/A

Medical information of child				
42. What is the main reason for taking your child to the clinic?	Weighing[1]	When immunisation is due[2]	When the child is sick[3]	Other[4]
43. Does your child have any chronic illnesses?			Yes[1]	No[2]
44. What chronic illness?				N/A

45. Did your child have any illness in the last 4 weeks? If any, when?	No[1]	Respiratory infection[2]	More than 4 watery stools in 24h[3]	Fever[4]	Poor appetite[5]	Other[6] .....

46. Did your child receive any vitamin A during the last 12 months?	Yes[1]	No[2]
47. If yes, when?		

Information from the Road to Health Chart

48. Does your child have a Road to Health Chart?	Yes[1]		No[2]				
49. Date of birth of child:	D	D	M	M	Y	Y	
50. Birth weight of baby (g)							
51. Birth length of baby (cm)							
52. Baby's head circumference at birth (cm)							
53. Gestational age (weeks)							

54. Mother received Vitamin A at the birth of the baby. Date: ……..	Yes[1]	No[2]
55. Baby received Vitamin A at birth or within 6 weeks after birth at the clinic. (if formula fed)	Yes[1]	No[2]

56. Dates on which the child received Vitamin A according to the blanket Vitamin A protocol.	Dates given: ……. ……. ……. ……. …… …….. …… ……..	6 months	12 months	18 months	24 months	30 months
		36 months	42 months	48 months	54 months	60 months

57. Child received additional Vitamin A and reason.	Yes[1]:…… ……	No[2]

Anthropometric data

58. Weight of mother (kg)	1:	2:	3:	Average:
59. Height of mother (cm)	1:	2:	3:	Average:
60. Weight of child (kg)	1:	2:	3:	Average:
61. Height / Length of child (cm)	1:	2:	3:	Average:
62. MUAC of child (mm)	1:	2:	3:	Average:

Information from the child's clinic file

63. Baby received Vitamin A at birth or within 6 weeks after birth at the clinic. (if formula fed)	Yes[1]				No[2]	
64. Dates on which the child received Vitamin A according to	Dates given: ……. …….	6 months	12 months	18 months	24 months	30 months

the blanket Vitamin A protocol.	……. ……. …… …….. …… ……..	36 months	42 months	48 months	54 months	60 months
65. Child received additional Vitamin A and reason.		Yes[1]…… ……		No[2]		

Kode:

Faktore wat bydra tot die vitamien A en antropometriese status van kinders, 24 tot 59 maande oud, van 'n gemeenskap in die Noord Kaap, Suid Afrika.

Algemene Vraelys

1. Naam van persoon wat die vraelys voltooi:						
2. Datum:	D	D	M	M	J	J
3. Naam van moeder:						
4. Moeder se geboortedatum:	D	D	M	M	J	J

5. Hoeveel (eie) kinders het jy? Skryf die name en ouderdomme van alle kinders neer en merk die kind wat vir die studie gebruik gaan word.	Naam:	Ouderdom Jare	Maande
	Totale aantal kinders:		

6. Kind se geboortedatum:	D	D	M	M	J	J

7. Kind se geslag:	Manlik [1]	Vroulik [2]

Sosio-demografiese inligting

8. Adres:	**Blok nommer:**

9. Hoe lank woon jy al in Calvinia:	Jare:	Maande:

10a. Huwelik status:	Getroud[1]	Woon saam[2]	Enkel[3]	Geskei/ Vervreemd[4]	Weduwee[5]

10b. Lewe die biologiese pa van die kind nog?	Ja[1]	Nee[2]	Weet nie[3]

11. Wat is jou hoogste opvoedingsvlak? (Skryf neer en merk in ooreenstemmende blokkie) ……	Geen[0]	Gr 1-3[1]	Gr 4-7[2]	Gr 8-10[3]	Gr 11[4]	Gr 12[5]	Ander [6] ……..

12. Wie is die hoof van die huishouding?	Self[1]	Eggenoot/ metgesel[2]	Moeder/Vader[3]	Ander familie[4]	Ander / Onverwant[5]

13. Werk jy?	Ja[1]	Nee[2]

14. Het jy in die afgelope 12 maande gewerk?	Ja[1]	Nee[2]
15. Watter soort werk doen jy of het jy gedoen?		

16. Hoeveel mense slaap in die huis vir 5 of meer nagte van die week?	Aantal volwassenes:		
	Aantal kinders:	0 - 5 jaar	
		6 – 12 jaar	
		13 – 18 jaar	

17. Wat is die bronne van inkomste in die huishouding?	Eie inkomste[1]	Bedrag
	Eggenoot/metgesel se inkomste[2]	Bedrag
	Geldelike hulp van familie[3]	Bedrag
	Welsynstoelaag[4] (spesifiseer)	Bedrag
		Bedrag
		Bedrag
		Bedrag
	Pa buite huis (onderhoud)[5]	Bedrag
	Ander inkomste[5] (spesifiseer)	Bedrag
	Geen inkomste[6]	
	Totaal	Bedrag

18. Hoeveel geld spandeer jy in ‘n week aan kos?					
19. Beskikbaarheid van kos vir die huishouding:	Altyd genoeg kos vir almal in die huis[1]	Soms nie genoeg kos in die huis vir almal (twee keer per maand of meer)[2]	Meeste van die tyd nie genoeg kos vir almal (twee keer per week of meer)[3]	Ander[4] …….……	
20. Kry jy ook kos van ander **bronne** ?	Familie[1]	Bure of vriende[2]	Welsyn[3]	Ander[4] ……	Nee[5]
21. Tipe huis	Formele huis[1]	HOP huis[2]	Agterplaas verblyf [3]	Opslaan huis op ‘n oop veld/plot[4]	
22. Is die huis gebou van:	Stene en sement[1]	Klei[2]	Sinkplaat[3]	Hout[4]	
23. Hoeveel vertrekke het die huis: (uitgesluit: badkamer, toilet, kombuis)					
24. Van waar kom die huishouding se drinkwater?	Kraan binne die huis[1]	Kraan buite die huis[2]	Bure se kraan[3]	Openbare kraan[4]	Ander, spesifiseer ……..[5]
25. Watter tipe brandstof gebruik die houshouding vir kook?	Elektrisiteit[1]	Gas[2]	Paraffien[3]	Hout / oop vuur binne die huis[4]	Hout / oop vuur buite die huis[5]
26. Watter toilet geriewe word deur die huishouding gebruik?	Spoel toilet, binne in die huis[1]	Spoel toilet, buite die huis[2]	Emmer[3]	Ander[4] (spesifiseer) ……..	

27. Watter bates het die huishouding? (meer as een item toegelaat)	Yskas[1]	TV[2]	Selfoon[3]	Motor[4]
Rook gewoontes / Drank gebruik				
28. Rook jy?	Ja[1]	Nee[2]		
29. Wat rook jy?	Sigarette[1]	Twakpille[2]	Ander[3]	NVT[4]
30. Hoeveel rook jy per dag?	Sigarette / Twakpille / Pyp:			NVT
31. Het jy gerook terwyl jy swanger was met die kind wat aan die studie deelneem?	Ja[1]	Nee[2]		
32. Hoeveel sigarette / keer het jy per dag gerook?				NVT
33. Drink jy enige alkohol?	Ja[1]	Nee[2]		
34. Wat drink jy?	Bier[1]	Wyn[2]	Sterk drank[3]	NVT[4]
35. Hoe gereeld drink jy?	Elke dag[1]	Naweke[2]	Ander[3]:	NVT
36. Hoeveel drink jy op 'n slag?				NVT
37. Het jy alkohol gedrink terwyl jy swanger was met die kind wat aan die studie deelneem?	Ja[1]	Nee[2]		
38. Hoeveel het jy gedrink?				NVT
Borsvoedingspatrone				
39. Watter soort melk drink jou kind op die oomblik? (Meer as een opsie kan gekies word)	Borsmelk[1]	Formule melk[2]	Koeimelk[3]	Ander[4] ..... Net saam met kos[5] Geen[6]
40. Was die kind vantevore geborsvoed?	Ja[1]	Nee[2]		
41. Tot watter ouderdom is jou kind geborsvoed?				NVT
Mediese inligting van die kind (soos geraporteer deur ma)				
42. Wat is die belangrikste rede waarvoor jy jou kind in die afgelope 12 maande kliniek toe geneem het?	Weeg[1]	Immunisasie[2]	Siekte[3]	Neem kind nie meer na kliniek / nie laaste 12 mde by kliniek[4] Ander[5]

43. Toe die kind die afgelope 6 maande by kliniek was, wat van die volgende was gedoen *(kan meer as 1 besoek wees)*?	Kind geweeg[1]	Kind ge-immuniseer[2]	Vitamien A ontvang[3]	Behandeling vir siekte ontvang[4]	Vitamiene of yster gekry[5]	Kind nie afgelope 6 maande by kliniek[6]	Ander[7]

44. Het jou kind enige siektes waaroor hy/sy opgevolg of behandel word by 'n kliniek, hospitaal of dokter (in laaste 12 maande)?	Ja[1]	Nee[2]
45. Watter siekte?		NVT
46a. Het jou kind enige siektes in die afgelope 4 weke gehad?	Ja[1]	Nee[2]

46b. Indien enige, wat en wanneer? (Ja=1; Nee=2) ……..	Respiratoriese infeksie	Meer as 4 waterige stoelgange in 24h	Koors	Swak eetlus	Ander ……

47. Het jou kind enige vitamien A in die laaste 12 maande ontvang?	Ja[1]	Nee[2]

48. Indien ja, wanneer en waar?	Kliniek[1] ……	Creche[2] ……	Gemeenskap[3] ……	Hospitaal[4] ……	Ander[5] ……

Inligting vanaf die groeikaart (RtHC)

49. Het jou kind 'n groeikaart (RtHC)?	Ja[1]	Nee[2]

50. Geboortedatum van kind:	D	D	M	M	J	J

51. Gewig by geboorte (g)	
52. Lengte by geboorte (cm)	
53. Kopomtrek by geboorte (cm)	
54. Gestasie ouderdom (weke)	

55. Moeder het vitamien A by baba se geboorte ontvang. Datum: ……..	Ja[1]	Nee[2]

56. Baba het vitamien A by geboorte ontvang of binne 6 weke na geboorte. (indien formule voeding)	Ja[1]	Nee[2]	NVT[3] (bors)

57. Datums waarop kind vitamien A ontvang het volgens vitamien A voorkomings protokol.	Datums gegee: …… …… …… …… …… …….. …… ……..	6 maande	12 maande	18 maande	24 maande	30 maande
		36 maande	42 maande	48 maande	54 maande	60 maande

58. Kind het addisionele vitamien A ontvang en rede.	Ja[1]: ……	Nee[2]
59. Kind het vitamien A tydens veldtog ontvang en datums:	Ja[1] …… ……	Nee[2]

Anthropometriese inligting				
60. Moeder se gewig (kg)	1:	2:	3:	Gemiddeld:
61. Moeder se lengte (cm)	1:	2:	3:	Gemiddeld:
62. Kind se gewig (kg)	1:	2:	3:	Gemiddeld:
63. Kind se hoogte / lengte (cm)	1:	2:	3:	Gemiddeld:
64. Bo arm omtrek van kind (mm)	1:	2:	3:	Gemiddeld:

Inligting vanaf die kind se kliniek rekords

65. Baba het vitamien A by geboorte of binne 6 weke na geboorte by die kliniek gekry: (formule voeding)	Ja[1]	Nee[2]	NVT[3] (bors)

66. Datums waarop die kind vitamien A gekry het volgens die vitamien A protokol	Datums gegee: …… …… ……. …… …… …… …… ……	6 maande	12 maande	18 maande	24 maande	30 maande
		36 maande	42 maande	48 maande	54 maande	60 maande

67. Kind het addisionele vitamien A ontvang en rede.	Ja[1] …… ……	Nee[2]
68. Datum van laaste kliniek besoek volgens kliniek rekords:		

Code:

24 Hour Dietary Recall – Child

Interviewer: …….. Date of Interview: ……..…… Day of Week: ……..	Sex: …… Age: ……

Did your child stay with someone yesterday where he / she ate?	Yes [1]	No [2]

With whom?	When?

Timeframe	What did he/she eat or drink?	How was the food or drink prepared?	What was added?	How much did he/she eat?
Before breakfast				
Breakfast				
In between				
Lunch				
In between				
Dinner				
After dinner				

Is your child taking any vitamin supplements? If yes, what. (Ask to see supplements and write down name, whether it contains vitamin A and how much)	

Kode:

24 uur Dieet Herroep – Kind

Ondervraer: ……..	Geslag:……
Datum: ……..……	Ouderdom: ……
Dag van die week: ……..	

Het jou kind gister by iemand anders gebly waar hy / sy geëet het?	Ja [1]	Nee [2]

By wie?	Wanneer?

Tyd	**Wat het hy / sy geëet of drink?**	**Hoe was die kos gaargemaak?**	**Wat was bygevoeg?**	**Hoeveel het hy / sy geëet / drink?**
Voor ontbyt				
Ontbyt				
Tussen in				
Middagete				
Tussen in				
Aandete				
Na aandete				

Gebruik jou kind enige vitamiene? As ja, wat? (Vra om die supplement te sien en skryf die naam neer en of dit vitamien A bevat en hoeveel)	

Code:

Factors contributing to the vitamin A and anthropometric status of 24 to 59-month-old children from a Northern Cape community, South Africa.

Liver intake questionnaire

1. Do the people in your household eat liver?	Yes[1]	No[2]
2. Did you prepare liver during the past 4 weeks?	Yes[1]	No[2]
3. Does your child eat liver?	Yes[1]	No[2]
4. Did your child eat liver during the past 4 weeks?	Yes[1]	No[2]

5. If "yes", in which form?

	How many times in the last 4 weeks?	How much (portion size)	Office use: (calculate the amount of liver per day / per month)		
			Per month	Per day	Vit A (µgRE/day)
Fried [1]					
Fried with onions [2]					
Cooked [3]					
Liver cakes [4]					
"Skilpadjie" [5]					
"Pofadder" [6]					
Chicken livers [7]					
Beef liver [8]					
"Harslag" [9]					
Other [10,] specify:					

6. If "no" when last did your child eat liver?	
7. How often does the child eat liver?	
8. From which age does your child eat liver?	

9. Where do you get the liver?	At the butchery [1]	At the abattoir [2]	From people who work at the abattoir [3]	From friends and family [4]	At the supermarket [5]	Other [6] .....
10. How much do you pay for it?						

11. Are there certain times of the year when you eat liver more frequently than usual (circle)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All

Kode:

Faktore wat bydra tot die vitamien A en antropometriese status van kinders, 24 tot 59 maande oud, van 'n gemeenskap in die Noord Kaap, Suid Afrika.

Vraelys: lewer inname

1. Eet die mense in jou huishouding lewer?	Ja[1]	Nee[2]
2. Het jy lewer in die afgelope 4 weke gaargemaak?	Ja[1]	Nee[2]
3. Eet jou kind lewer?	Ja[1]	Nee[2]
4. Het jou kind in die afgelope 4 weke lewer geëet?	Ja[1]	Nee[2]

5. Indien "ja", in watter vorm?

	Hoeveel keer in die laaste 4 weke?	Hoeveel (porsie grootte)	Kantoor gebruik: (bereken die hoeveelheid lewer per maand / per dag)		
			Per maand	Per dag	Vit A (µgRE/dag)
Gebraai[1]					
Gebraai met uie[2]					
Gekook[3]					
Lewer koekies[4]					
"Skilpadjies"[5]					
"Pofadder"[6]					
Hoender lewer[7]					
Bees lewer[8]					
"Harslag"[9]					
Ander:[10]					

6. Indien "nee" wanneer laas het jou kind lewer geëet?	
7. Hoe gereeld eet jou kind lewer en wanneer hy eet hoeveel?	
8. Van watter ouderdom af eet jou kind lewer?	

9. Waar kry jy die lewer?	By die slaghuis[1]	By die slagpale[2]	By mense wat by die slagpale werk[3]	Vanaf vriende en familie[4]	By die winkel[5]	Ander[6] ……
10. Hoeveel betaal jy daarvoor?						

11. Is daar sekere tye van die jaar wat julle meer lewer eet as gewoonlik (sirkel)	Jan	Feb	Mar	Apr	Mei	Jun	Jul	Aug	Sep	Okt	Nov	Des	Al-mal

PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM

TITLE OF THE RESEARCH PROJECT:
Factors contributing to the vitamin A and anthropometric status of 24 to 59-month old children from a Northern Cape community, South Africa.

REFERENCE NUMBER: N10/03/068

PRINCIPAL INVESTIGATOR:
Jana Nel

ADDRESS:
Abraham Esau Hospital
Cnr Hofmeyer and Inry Street
Calvinia
8190

CONTACT NUMBER:
Work: 027 341 8020 (Extension 8106)
Cell: 082 735 9299

You are invited to take part in a research project. Please take some time to read this information, which explains the details of this project. If you have any questions or do not fully understand any part of this study, please feel free to ask the researcher about it. It is very important that you fully understand what this research is about and what will be expected from you. Your participation is **voluntary** and you may refuse to participate. If you refuse, it will not affect you negatively in any way. You are also free to withdraw from the study at any stage or refuse to answer any questions you may not feel comfortable with, even though you have agreed to participate. The estimated time that you will be interviewed is 45 minutes.

This study has been approved by the **Health Research Ethics Committee (HREC) of Stellenbosch University** and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

The study
The study will focus on nutrition and will be conducted in the Calvinia West community on a total of 200 pre-school children and their mothers. Good nutrition is important for the health and development of young children. The aim of this study is to determine the nutritional status of pre-school children living in Calvinia West and to look at the factors that might influence their nutrition. You will be asked questions about your and your child's health; your child's eating patterns and questions on your household. The information will be recorded on a questionnaire. Your weight and height, as well as that of your child, will also be measured. All households in Calvinia West with a child between 2 and 5 years old will be asked to participate in the study and only one child per household will be selected.

All information collected will be treated as confidential and will be protected. You will be given a number and your name will never be used. Only the investigator and fieldworker will have access to your information.

The results of this study will give us important information on the nutritional status of the children living in Calvinia West and may also help the Department of Health in the planning of health and nutrition programmes.

- You will not be paid to take part in the study and it will not cost you anything to take part.
- You can contact Jana Nel at 027-341 8020 (Ext 8106) if you have any further questions or encounter any problems.
- You can contact the **Health Research Ethics Committee** at 021-938 9207 if you have any concerns or complaints that have not been adequately addressed by the researcher.
- You will receive a copy of this information and consent form for your own records.

Declaration by participant

By signing below, I ……..……. agree to take part in a research study entitled: Factors contributing to the vitamin A and anthropometric status of 24 to 59-month-old children from a Northern Cape community, South Africa.

I declare that:

- I have read (or had read to me) this information and consent form and it is written in a language in which I am fluent and comfortable with.
- I have had a chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.
- I may choose not to answer any questions which I do not feel comfortable with and will not be penalised or prejudiced in any way.

Signed at (*place*) ....….....…….. on (*date*) ……...…….. 2010.

....
Signature of participant **Signature of witness**

Declaration by investigator

I *(name)* ……..…… declare that:

- I explained the information in this document to ……..
- I encouraged her to ask questions and took adequate time to answer them.
- I am satisfied that she adequately understands all aspects of the study, as discussed above.

Signed at (*place*) ....….....…….. on (*date*) ……...…….. 2010.

....
Signature of investigator **Signature of witness**

DEELNEMERINLIGTINGSBLAD EN -TOESTEMMINGSVORM

TITEL VAN DIE NAVORSINGSPROJEK:
Faktore wat bydra tot die vitamien A en antropometriese status van kinders, 24 tot 59 maande oud, van ‘n gemeenskap in die Noord Kaap, Suid Afrika.

VERWYSINGSNOMMER: N10/03/068

HOOFNAVORSER:
Jana Nel

ADRES:
Abraham Esau Hospitaal
H/v Hofmeyer en Inry straat
Calvinia
8190

KONTAKNOMMER:
Werk: 027 341 8020 (Uitbreiding 8106)
Sel: 082 735 9299

U word genooi om deel te neem aan ’n navorsingsprojek. Lees asseblief hierdie inligtingsblad op u tyd deur aangesien die besonderhede van die navorsingsprojek daarin verduidelik word. Indien daar enige deel van die navorsingsprojek is wat u nie ten volle verstaan nie, is u welkom om die navorser daaroor uit te vra. Dit is baie belangrik dat u ten volle moet verstaan wat die navorsingsprojek behels en wat van u verwag gaan word. U deelname is **volkome vrywillig** en u mag deelname weier. U sal op geen wyse hoegenaamd negatief beïnvloed word indien u sou weier om deel te neem nie. U mag ook te eniger tyd aan die navorsingsprojek onttrek of weier om enige vrae te antwoord waarmee u ongemaklik voel, selfs al het u ingestem om deel te neem.
Die duurte van die onderhoud sal ongeveer 45 minute wees.

Hierdie navorsingsprojek is deur die Komitee vir **Mensnavorsing van die Universiteit Stellenbosch** goedgekeur en sal uitgevoer word volgens die etiese riglyne en beginsels van die Internasionale Verklaring van Helsinki, Suid Afrikaanse Riglyne vir Goeie Kliniese Praktyke en die Etiese Riglyne vir Navorsing van die Mediese Navorsingsraad (MNR).

Die studie
Die studie gaan fokus op voeding en gaan in die Calvinia Wes gemeenskap gedoen word op ‘n totaal van 200 voorskoolse kinders en hul moeders. Goeie voeding is belangrik vir die gesondheid en ontwikkeling van jong kinders. Die doel van die studie is om die voedingstatus van voorskoolse kinders in Calvinia Wes te bepaal en te kyk na die faktore wat ‘n invloed kan hê op hul voeding. U sal vrae gevra word oor u en u kind se gesondheid; u kind se eetpatroon en vrae oor u huishouding. Die inligting sal op ‘n vraelys aangeteken word. U en u kind se gewig en lengte sal ook geneem word. Alle huishoudings in Calvinia Wes met ‘n kind tussen 2 en 5 jaar oud, sal gevra word om aan die studie deel te neem. Slegs een kind sal per huishouding gekies word.

Alle inligting wat u gee sal konfidensieël gehou word. ‘n Kode sal aan u toegeken word en u naam sal nooit gebruik word nie. Slegs die navorser en veldwerker sal toegang tot u inligting hê.

Die uitslae van die studie sal vir ons belangrike inligting gee oor die voedingstatus van die kinders wat in Calvinia Wes woon en kan ook die Departement van Gesondheid help in die beplanning van gesondheids en voedingsprogramme.

- U sal nie betaal word vir deelname aan die navorsingsprojek nie en deelname aan die navorsingsprojek sal u niks kos nie.
- U kan Jana Nel kontak by 027-341 8020 (Uitbreiding 8106) indien u enige verdere vrae het of enige probleme ondervind.
- U kan die **Komitee vir Mensnavorsing** kontak by 021-938 9207 indien u enige bekommernis of klagte het wat nie bevredigend deur die navorser hanteer is nie.
- U sal 'n afskrif van hierdie inligtings- en toestemmingsvorm ontvang vir u eie rekords.

Verklaring deur deelnemer

Met die ondertekening van hierdie dokument onderneem ek, ……....…….., om deel te neem aan 'n navorsingsprojek getiteld: Faktore wat bydra tot die vitamien A en antropometriese status van kinders, 24 tot 59 maande oud, van 'n gemeenskap in die Noord Kaap, Suid Afrika

Ek verklaar dat:

- Ek hierdie inligtings- en toestemmingsvorm gelees het of aan my laat voorlees het en dat dit in 'n taal geskryf is waarin ek vaardig en gemaklik mee is.
- Ek geleentheid gehad het om vrae te stel en dat al my vrae bevredigend beantwoord is.
- Ek verstaan dat deelname aan hierdie navorsingsprojek **vrywillig** is en dat daar geen druk op my geplaas is om deel te neem nie.
- Ek te eniger tyd aan die navorsingsprojek mag onttrek en dat ek nie op enige wyse daardeur benadeel sal word nie.

Geteken te *(plek)* .....…….. op *(datum)* ……...…….. 2010.

....

Handtekening van deelnemer **Handtekening van getuie**

Verklaring deur navorser

Ek *(naam)* ……...…… verklaar dat:

- Ek die inligting in hierdie dokument verduidelik het aan:

  .....……..

- Ek haar aangemoedig het om vrae te vra en voldoende tyd gebruik het om dit te beantwoord.
- Ek tevrede is dat sy al die aspekte van die navorsingsprojek soos hierbo bespreek, voldoende verstaan.

Geteken te *(plek)* .....…….. op *(datum)* ……...…….. 2010.

.....	.....
Handtekening van navorser	**Handtekening van getuie**